21 OCTOBER 1954 NINEPENCE

ELECTRICAL TIMES

FROM THE FIRST TOUCH of colder weather millions of people will be reading about the cosy comfort offered by Memvair electric convectors. Selling advertisements will appear through the autumn and winter in 'Radio Times' and in selected national newspapers and magazines with a total readership of 28 millions. Make certain you profit from this advertising by having ample stocks to meet the demand.

Millions will read about the MEMVAIR Electric Convector Heater

Three ratings now: Memvair is now made in 1, 1½ and 2 kW ratings, each with or without thermostat.

Send for new Memvair Folder No. 352.

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Tyseley, Birmingham, 11 *Branches in London and Manchester*

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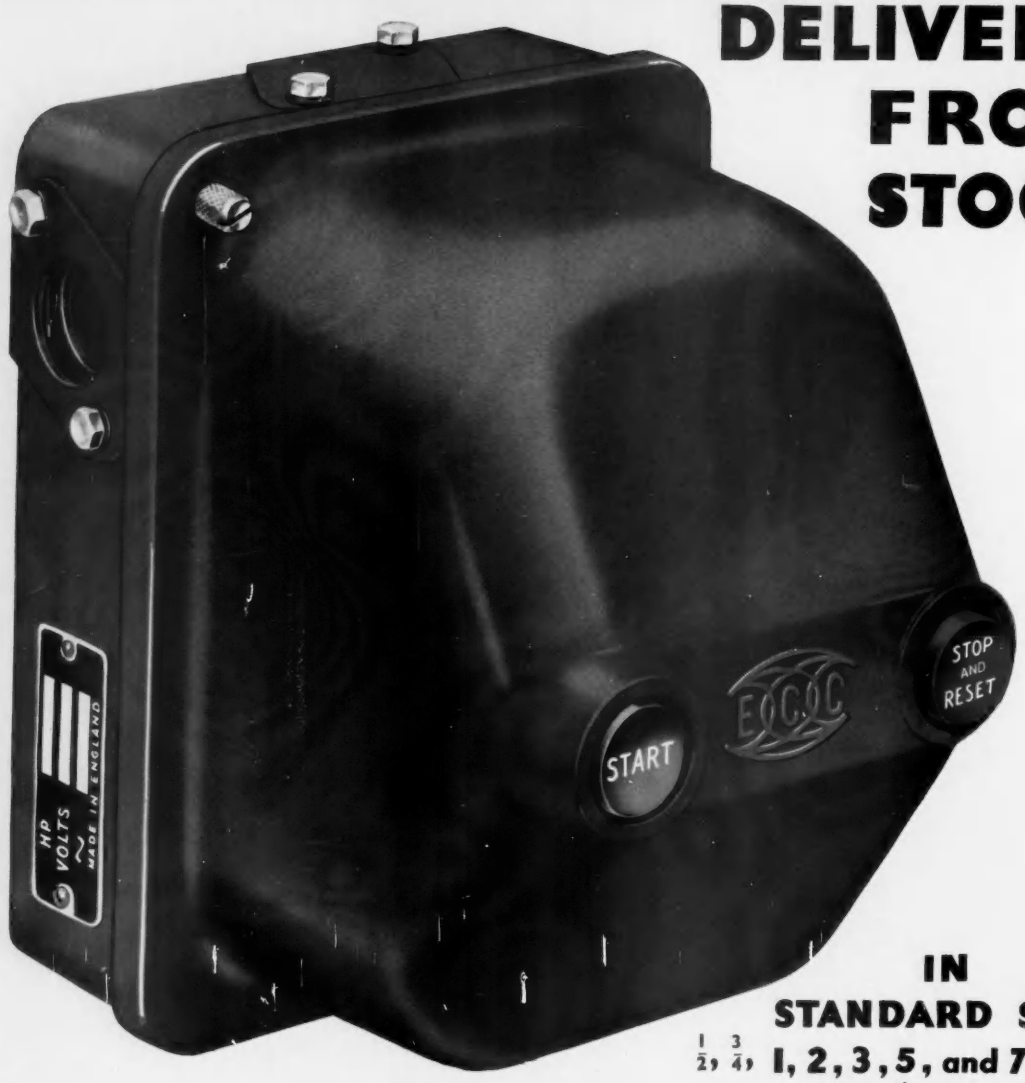

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2660

Manufacturers of Rotating Electrical Machinery, Switch and Control Gear, Rectifiers and Transformers.

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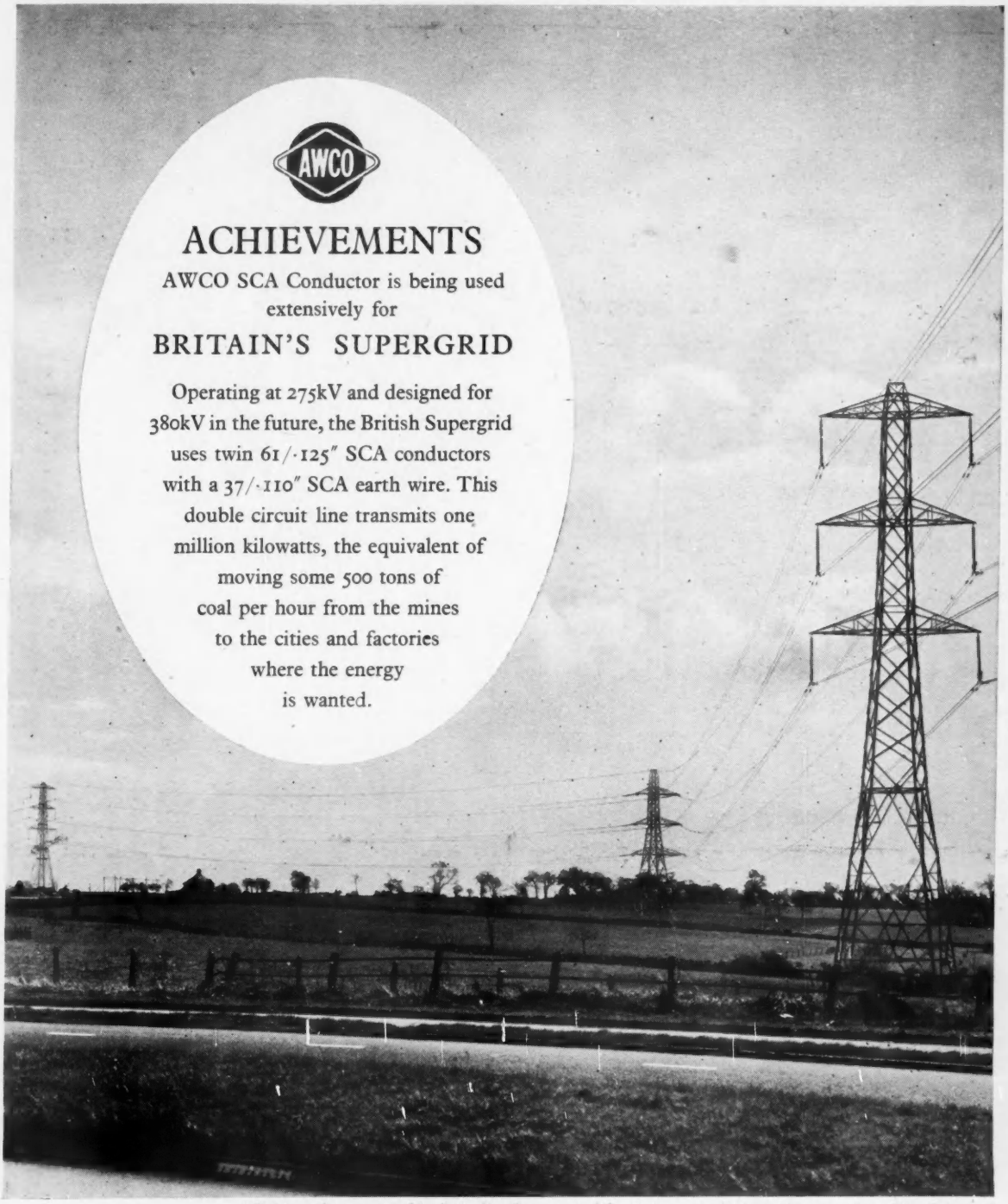
AWCO
ACHIEVEMENTS
AWCO SCA Conductor is being used extensively for
BRITAIN'S SUPERGRID
Operating at 275kV and designed for 380kV in the future, the British Supergrid uses twin 61/·125″ SCA conductors with a 37/·110″ SCA earth wire. This double circuit line transmits one million kilowatts, the equivalent of moving some 500 tons of coal per hour from the mines to the cities and factories where the energy is wanted.

AWCO conductor erected by J. L. Eve Construction Co. Ltd., on the Tilbury-Elstree section of the Supergrid

ALUMINIUM WIRE & CABLE CO. LTD.

Britain's Largest Manufacturers of Aluminium Wire and Conductors

Head Office and Works: PORT TENNANT, SWANSEA, GLAMORGAN

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NEW GILLOTT *Cotswold*

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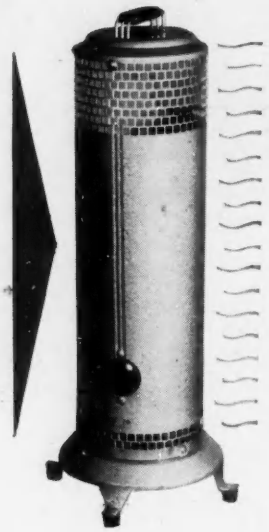
New — low in cost and economical to run. Safe — it is ideal for any room in the house. Used either on the floor or as a wall fitting, the 'Cotswold' heater silently fans hot air in Winter or cold air in Summer to the farthest corners of the room.

Of distinguished appearance, with neutral coloured body, deep maroon heat-resisting handle and die-cast stand.

THE MOST EFFECTIVE & ECONOMICAL FORM OF SPACE HEATING IN WINTER OR COOLING IN SUMMER

Regd. DESIGN. 874623



and the PROVED GILLOTT CONVECTOR HEATERS

Gloucester *(1½ Kw switched)* **&** ***Chalford*** *(1 Kw)*

THEY'RE ECONOMICAL, LOW PRICED AND SAFE

PROVED, ECONOMICAL, unequalled value. These all-purpose Domestic Electric Space Heaters give you steady, even warmth, effectively protected to avoid waste or overheating. Safe — Portable — Heatproof — Stable. Fine appearance, attractively finished in bronze.

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No job is too large or too small for us

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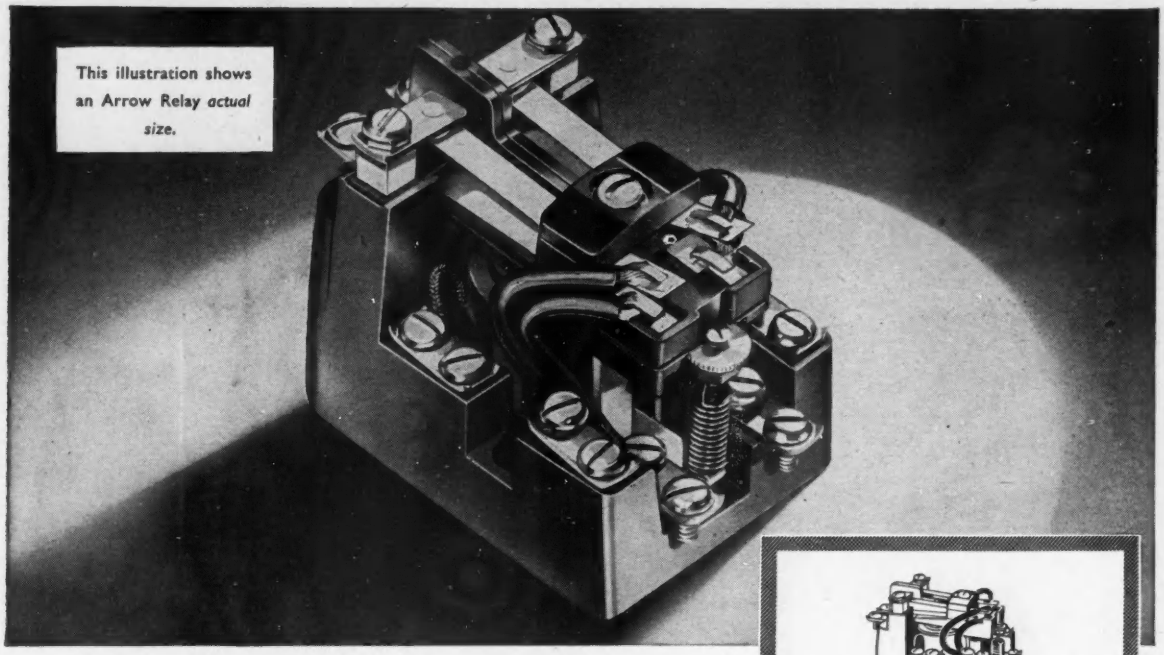
WE ARRANGE COLLECTION AND DELIVERY BY ROAD, RAIL, AIR OR SHIP

RELAYS for LONG AND SILENT SERVICE



Made by skilled craftsmen from first-quality materials, Arrow Relays, like all Arrow products, are individually produced; they are designed and built to ensure exceptionally long and silent service.

Essentially compact, no less than thirty different circuit arrangements are available on the standard base. Silver-to-silver butt type contacts give continuous rating up to 10 amps per pole at 230 volts AC. Operating coils, of low wattage consumption and continuously rated, are available for 6 to 550 volts AC and 6 to 230 volts DC.

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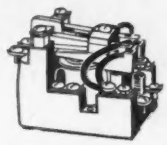
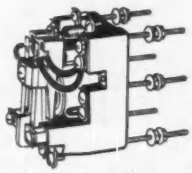
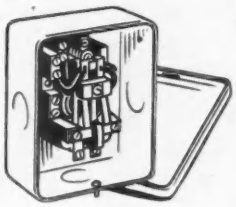


1. For surface mounting



2. For back of panel wiring

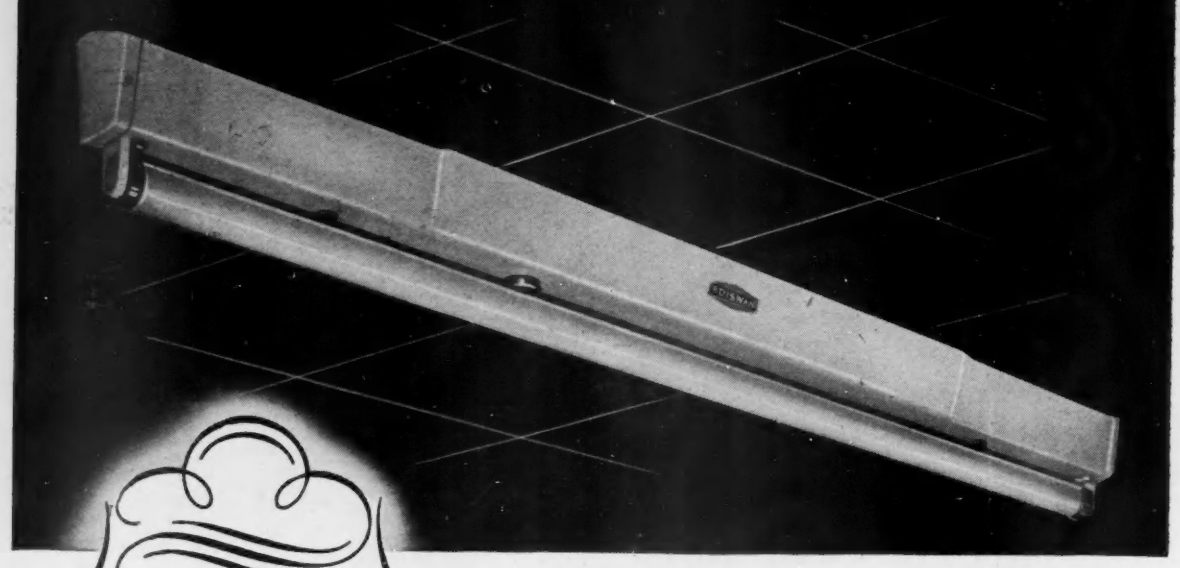


3. Enclosed

ARROW

ARROW ELECTRIC SWITCHES LTD · HANGER LANE · LONDON · W.5

Installation Costs CUT-



New low-priced 40 Watt 4ft. Ediswan lighting fitting

Cat. No. LS. 4007

The unit comprises a tapered channel body fitted with die cast ends. Into the top of the channel portion is fitted a sheet metal ceiling plate carrying the control gear.

The ceiling plate and channel are united by captive screws, the heads of which project on the underside of the channel. The sheet metal is pretreated before being finished glossy white stoved enamel.

The Patent "PENDICONE" fixing method enables the unit to be installed very quickly by one man. "PENDICONE" washers (patent applied for) used in conjunction with the two-way key slots in the ceiling plate allow the two c/s ceiling screws to be inserted before the ceiling plate is fixed to ceiling.

Price £5.6.8 complete with control gear for switch start at 200-250V. 50 cycles.

EDISWAN

Fluorescent Lighting Equipment

The 4 ft. fitting illustrated and the 5 ft. fitting of same design are offered for use in situations where bare lamps are acceptable. For the Ediswan range of fittings providing various forms of light control ask for Broadsheet No. LE.1788.

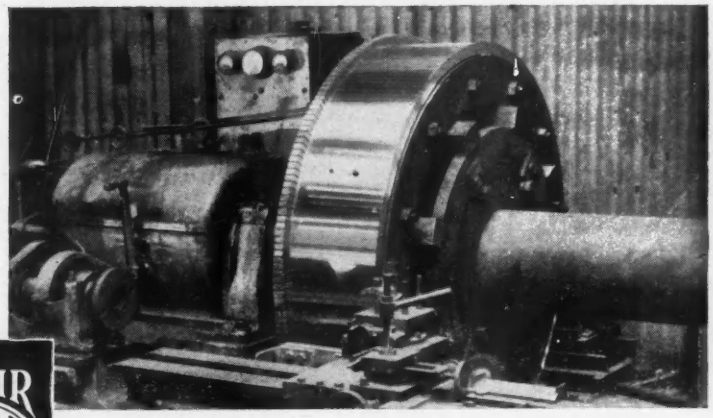
The Edison Swan Electric Co. Ltd., 155 Charing Cross Road, London, W.C.2.

Member of the A.E.I. Group of Companies.

LE 187d

Commutators . . .

We shall be pleased to have enquiries for the production of commutators up to a maximum of 10 ft. in diameter over the risers. B.E.R.L. Service is comprehensive in dismantling and repair or manufacture, erection and testing—and it is speedy. We remove defective commutators from machines in situ and fit and connect replacements. There are 14 B.E.R.L. Works, and the District Manager in your area is at your service. Ask B.E.R.L. to quote for your next job; in the meantime, write for a copy of our latest leaflet.



Illustrated are two stages in the manufacture of a 6 ft. diameter solid riser type commutator. The Photographs show (top) the machining of the Vees and (bottom) after machining of the brush surface diameter.

REPAIR B.E.R.L. SERVICE

BRITISH ELECTRICAL REPAIRS LIMITED,
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Works at: BATH, BIRMINGHAM, CARDIFF, CHESTERFIELD, EDINBURGH, GLASGOW, HAWICK, LONDON, MANCHESTER, NEWCASTLE, SWANSEA

dm BE 13

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Look out for these new big articulated vans. More of them are now on the roads and – with the opening of new extensions to our factory and more new plant coming into operation – we shall be able to give you bigger and better deliveries direct from our production line into your stores, without delay or damage.

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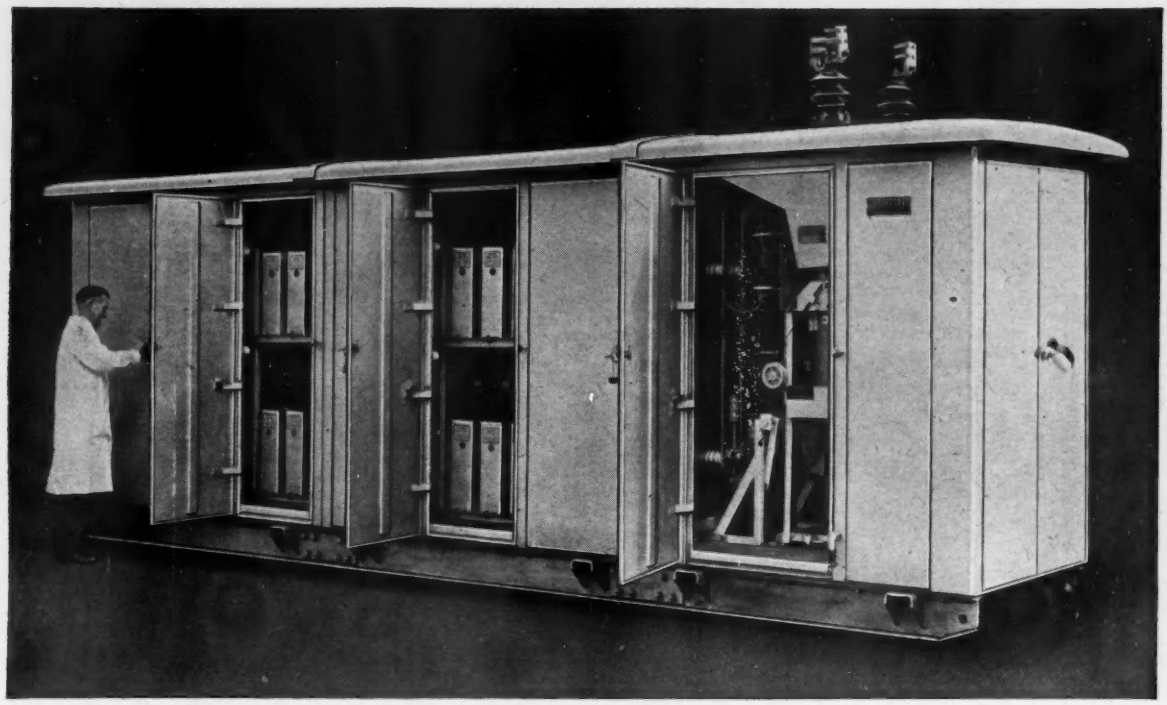
3000 kVAr in one housing



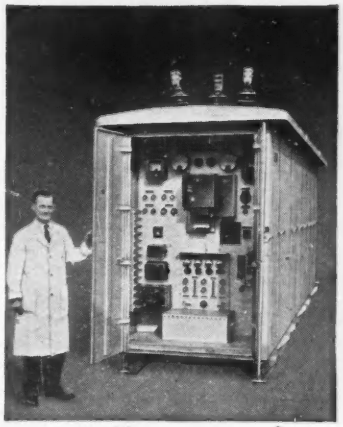
DUBILIER AUTOMATIC CAPACITOR BANKS FOR EXPORT

WE illustrate one of the four large high tension Banks recently completed for the Shell Company in Venezuela. They are the largest Capacitor Banks, complete in their housings, that have been built in this country.

The combined rated output is 4.5 MVAr, but they have been designed so that by adding further capacitor units to each housing this can be increased to 12 MVAr without altering the switch and control gear. The units are standard Dubilier high voltage type PFH Capacitors, which comprise a number of conservatively rated oil-impregnated paper dielectric capacitor sections arranged in series-parallel connections to suit the rated voltage of the capacitor unit. All these sections are constructed with extended foils which assist the cooling of the dielectric in the sections. Air circulation for cooling is provided by automatic fans which come into operation when the Capacitors are switched into circuit.

The switch, automatic control and protective equipment (see right) is mounted on a separate panel accessible through the doors at the end of the housing.

In addition to these large capacitors, we also manufacture Power Factor Correction Capacitors suitable for your factory. Our engineers are at your service to advise you whether the installation of Dubilier capacitors would be to your advantage.



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CONDENSER CO. (1925) LTD.

DUCON WORKS, VICTORIA ROAD, NORTH ACTON, LONDON, W.3

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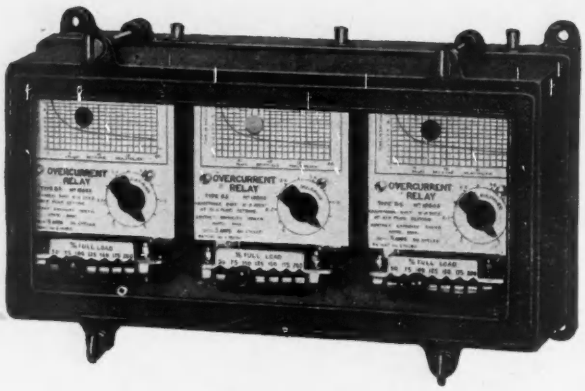
manufacture a wide range of Electrical Measuring Instruments — indicating, recording, switchboard, portable — high quality is characteristic of every type. All instruments conform to B.S.S. 89, cases being of Rectangular, Square, or Round pattern in die-cast aluminium or pressed steel, finished bright black stove enamel or other colour to customers' requirements. The specialities illustrated here are typical of the Nalders range.



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dimplex PERMANENTLY OIL-FILLED **ELECTRIC RADIATORS**

LOADINGS:
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Column type, 1½ and 2 kW.

for plug-in Central Heating

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CHAIRMAN WALTER F. HIGGS M.I.E.E.

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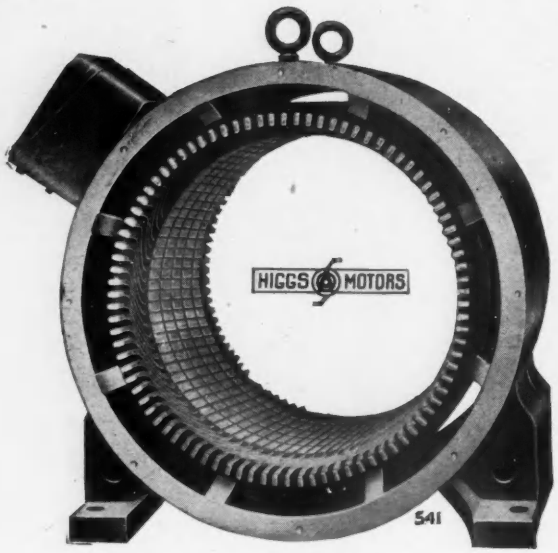

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Your enquiries will be welcomed.

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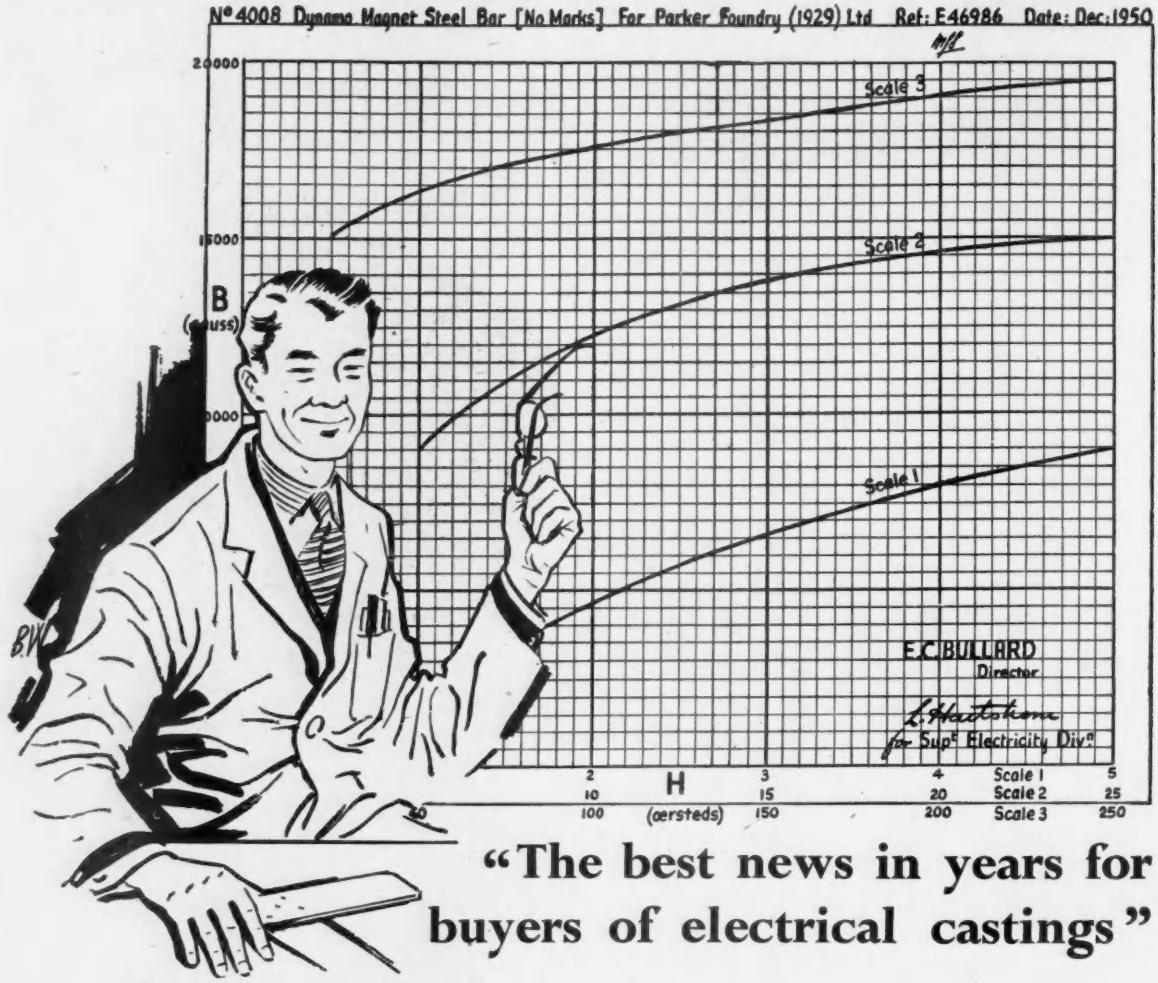

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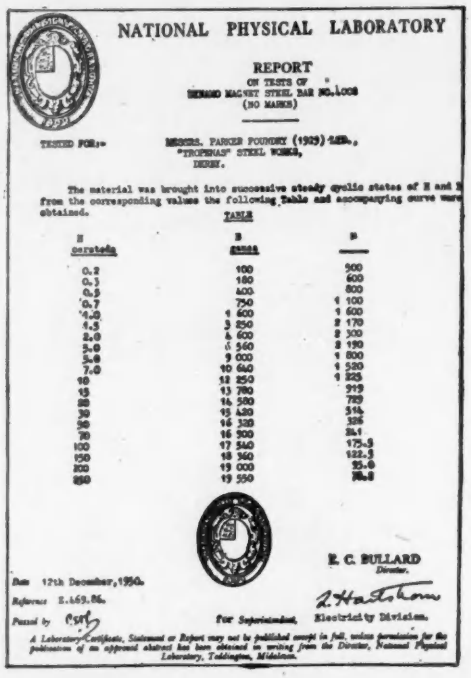
FROM their range of special purpose steels, Parker have developed a low carbon steel with high magnetic permeability (see N.P.L. permeability curve). Its mechanical properties are—yield stress 11/13 tons per sq. in. with ultimate stress of 22/26 tons per sq. in. Elongation is 32/28% with reduction of area 50/40%. All Parker castings are consistently accurate, are finely finished and have excellent machining properties. They are quality controlled from the sand bay to the fettling shop. *Write for your copy of the Parker Book of Special Purpose Steels.*



NATIONAL PHYSICAL LABORATORY

REPORT
ON TESTS OF
SEMAD MAGNET STEEL BAR NO. LOOS
(NO MARKS)

TESTED FOR:- MESSRS. PARKER FOUNDRY (1929) LTD.,
"TROPENAS" STEEL WORKS,
DERBY.

The material was brought into successive steady cyclic states of B and H from the corresponding values the following table and accompanying curve were obtained.

TABLE

H oersteds	B gauss	μ
0.2	100	500
0.3	180	600
0.5	400	800
0.7	750	1 100
1.0	1 400	1 400
1.5	3 250	2 170
2.0	4 600	2 300
3.0	6 540	2 180
5.0	9 000	1 800
7.0	10 640	1 520
10	12 250	1 225
12	13 780	919
15	14 580	729
20	15 420	514
30	16 320	326
50	16 920	84.1
70	17 540	175.5
100	18 360	122.5
150	19 000	95.0
200	19 550	78.2

E. C. BULLARD
Director.

Date 12th December, 1950.
Reference E.469.86.
Passed by C.G.S.
for Superintendent, Electricity Division.

A Laboratory Certificate, Statement or Report may not be published except in full, unless permission for the publication of an approved abstract has been obtained in writing from the Director, National Physical Laboratory, Teddington, Middlesex.

PARKER steel castings

for the electrical industry

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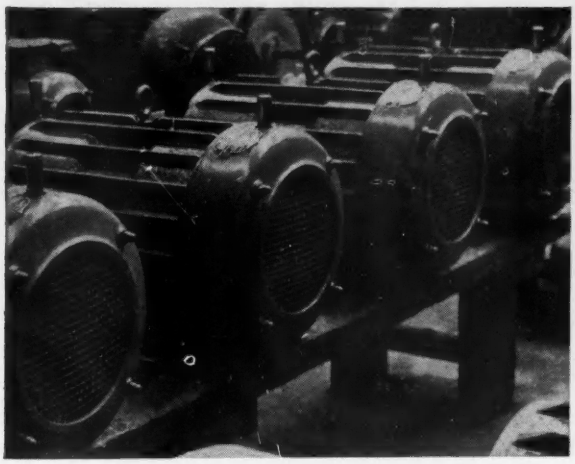
SILICONES
in the service of the
ELECTRICAL INDUSTRY
A NEW *class of* INSULATION

Part of an export consignment of twenty-five motors for Canada, for which silicone (Class H) insulation was specified, in order to ensure longer life and greater reliability under arduous conditions.

Wherever motors, transformers, magnet or heating coils operate in difficult conditions of high ambient temperature, high humidity, overload or chemical or oil contamination, silicones are the answer to insulation breakdown problems. Silicone insulants include resins and rubbers which, in combination with mica, glasscloth or asbestos form a completely new class of insulation. In heavy and light electrical engineering or electronics silicone insulants provide a safety factor against insulation breakdown not previously attainable.



(Photographs by courtesy of Lancashire Dynamo and Crypto Ltd.)

A complete range of silicone insulation components is available from insulation manufacturers. Silicone impregnating varnish and other silicones can be obtained direct from:

MIDLAND SILICONES LTD
(an associate company of ALBRIGHT & WILSON Ltd.)

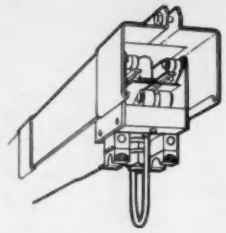
first *in British Silicones*

Ask for Silicone Notes:—
C17 *Silicones in Motor Windings*
C24 *Silicones in Transformer Windings*
C1 *Varnishes*
C19 *Insulation Component Suppliers List.*

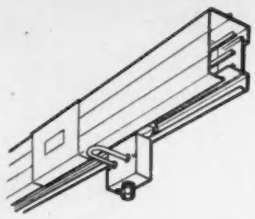
MS 19 UPPER BROOK STREET • LONDON • W.1 • TELEPHONE: GROSVENOR 4551

power all along the line

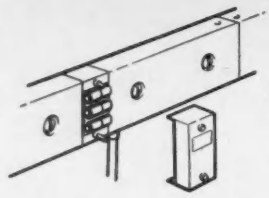
At all stations along the production line electrical power is readily available from E.M.S. distribution equipment. With these specialist products you have the safest and most economical form of power distribution for conveyor systems, portable tool installations, moveable pendant lights, etc. Write for literature giving full details of this equipment.



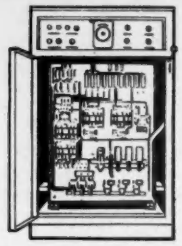
TROLLEY DUCT FEED RAIL Consisting of one or more trolley collectors running on continuous conductor rails, the E.M.S. Trolley Duct avoids long, trailing leads on portable Tool installations, conveyor systems, moveable pendant lights, etc.



"UNIDUCT" FEED RAIL Designed for 400 volt 3-phase supply, with a maximum loading of 100 amps per phase, the "Uniduct" is particularly suitable for high frequency tool installations on conveyor systems, small mobile cranes and hoists where bare conductors and trailing leads are dangerous.



"MINIBUS" DISTRIBUTION SYSTEM A miniature Busbar distributor system designed for small industrial installations where total loading does not exceed 100 amps per bar, and the load of each machine does not exceed 30 amps, available for 3-phase, 3- and 4-wire supplies.



CONTROL PANELS This automatic control panel built for Imperial Chemical Industries illustrates the type of work we can undertake. Panels can be supplied complete or in skeleton form for building-in.

E.M.S. ELECTRICAL PRODUCTS LTD

28-32 THE BUTTS COVENTRY TEL: COVENTRY 61091 GRAMS: DISPATCH COVENTRY

..... so we put them in touch with Griffiths, Gilbart, Lloyd and they soon cured the headache regarding automatic productions for the component parts.. In my opinion .....

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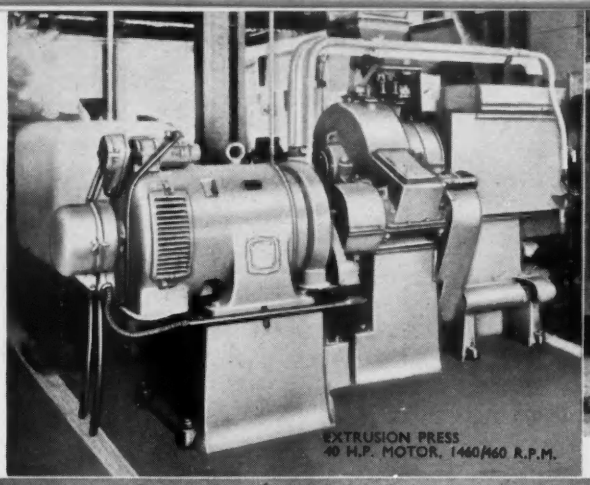
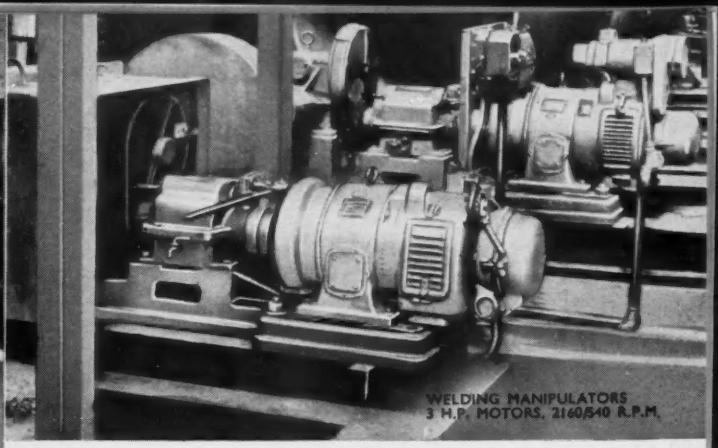
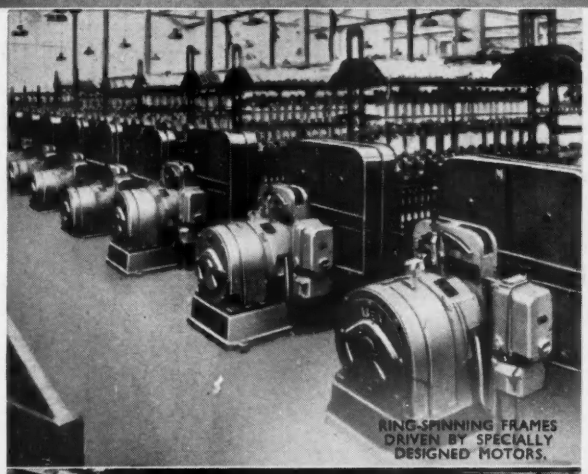


EXTRUSION PRESS
40 H.P. MOTOR, 1440/460 R.P.M.



WELDING MANIPULATORS
3 H.P. MOTORS, 2160/540 R.P.M.

3-PHASE COMMUTATOR MOTORS



RING-SPINNING FRAMES
DRIVEN BY SPECIALLY
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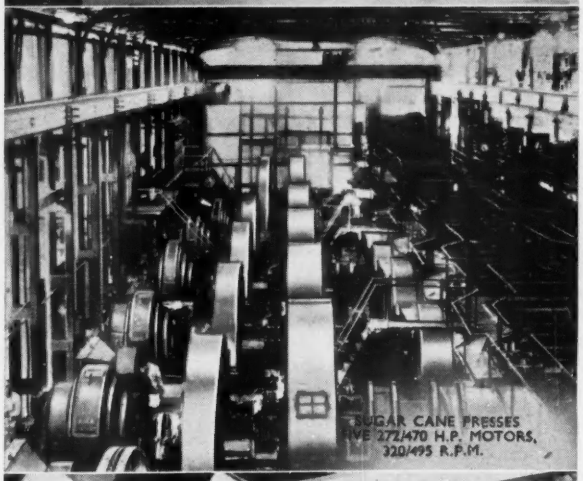
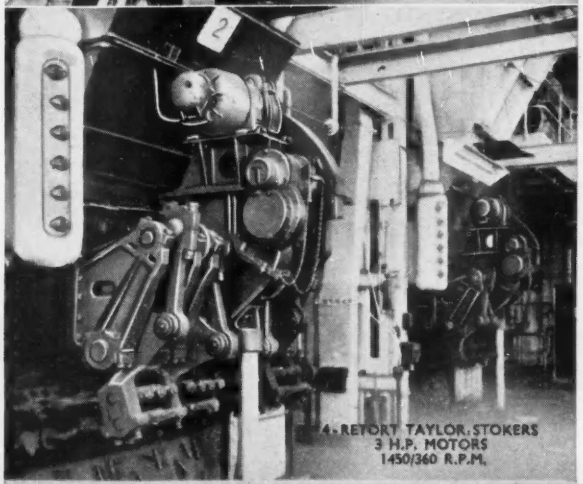


SUGAR CANE PRESSES
FIVE 272/470 H.P. MOTORS,
320/495 R.P.M.



4 - RETORT TAYLOR STOKERS
3 H.P. MOTORS
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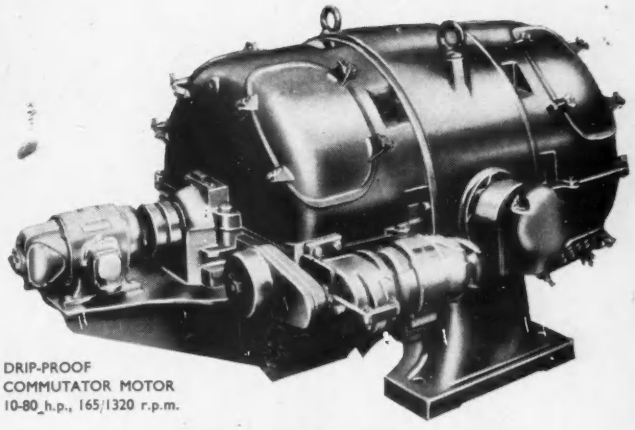

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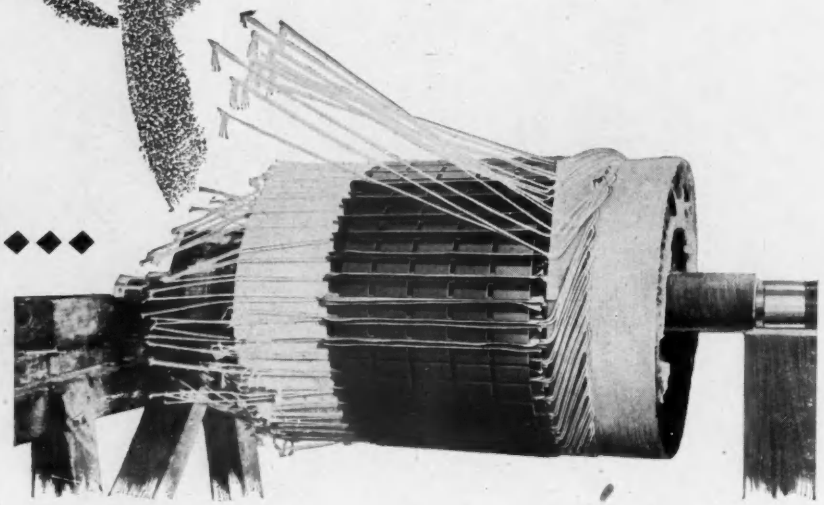

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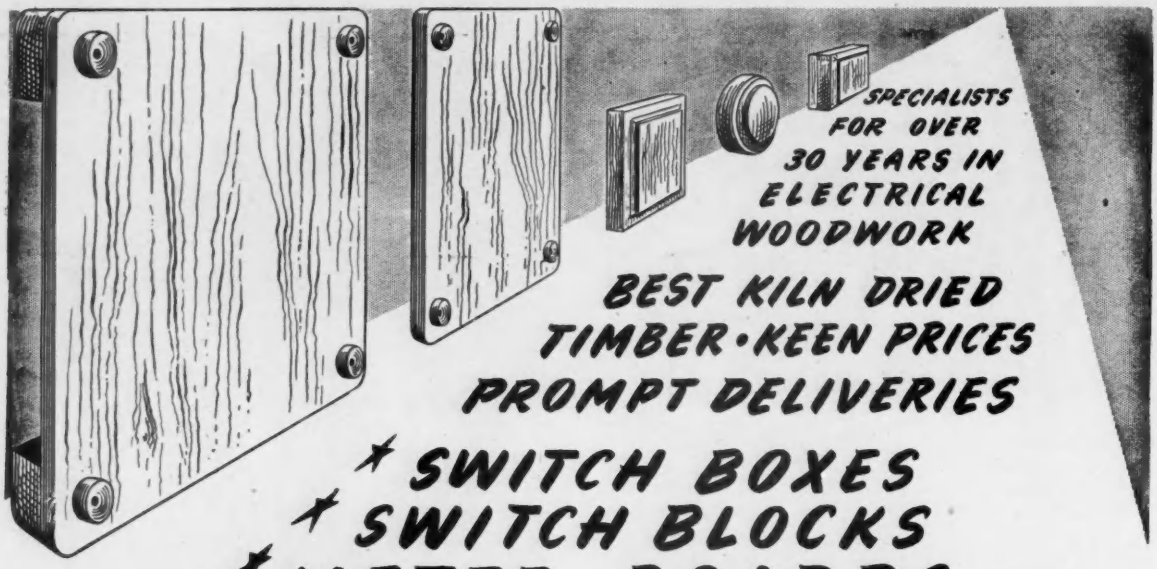

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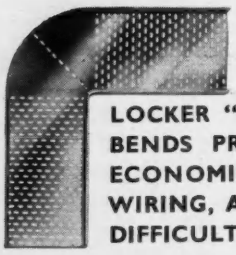

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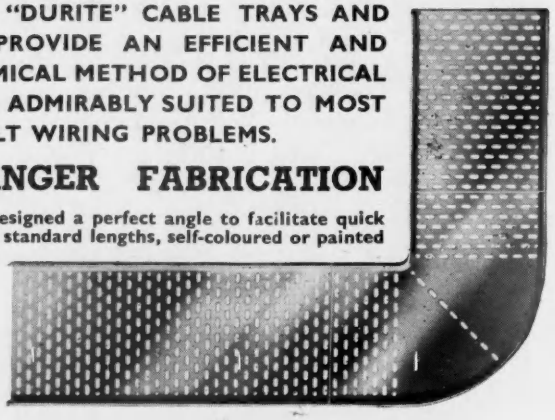

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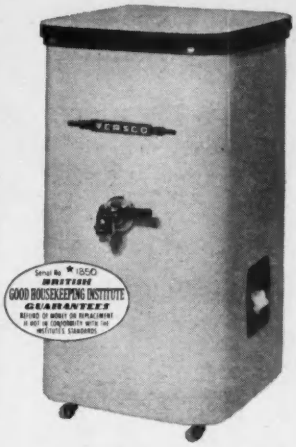

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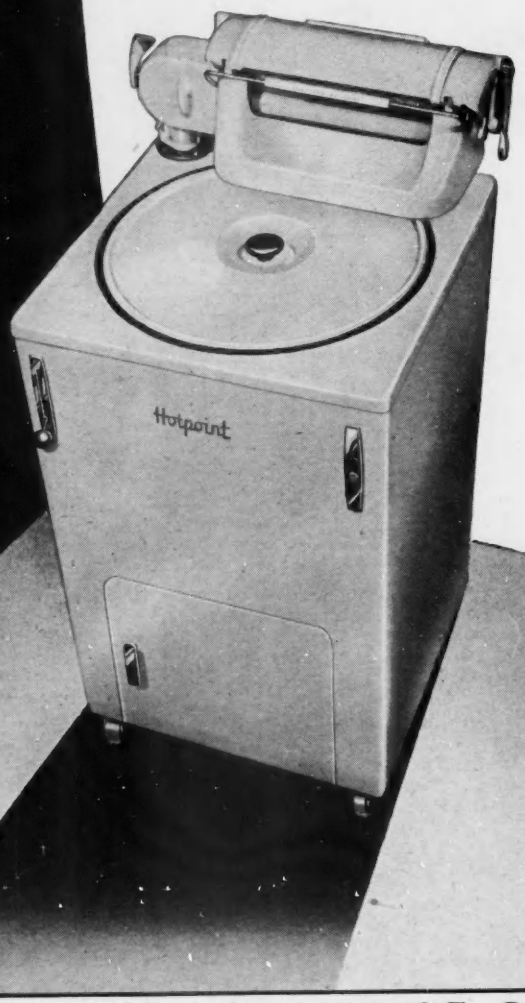

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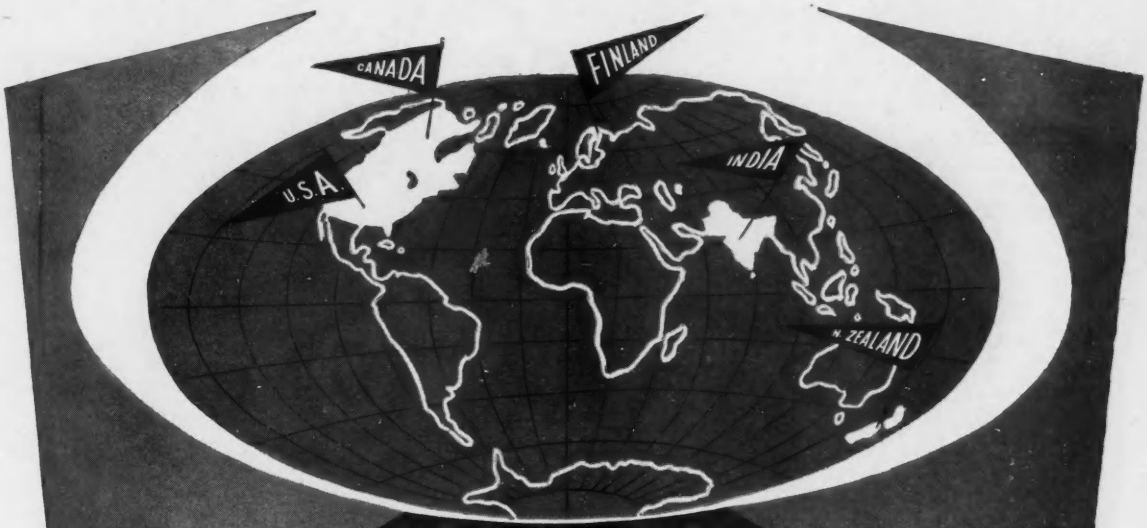

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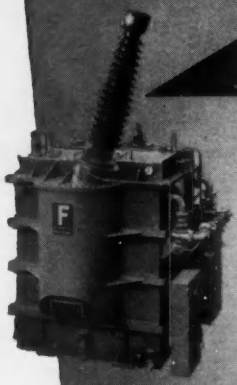
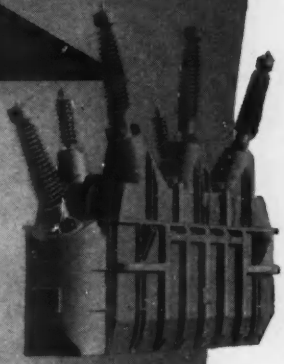


U.S.A. Nine 33,333 kVA, 230,000 volt single-phase Ferranti transformers are being supplied to the U.S. Army Corps of Engineers for the Garrison Dam Project, North Dakota, U.S.A. Three, forming the first 100,000 kVA bank, have been shipped.

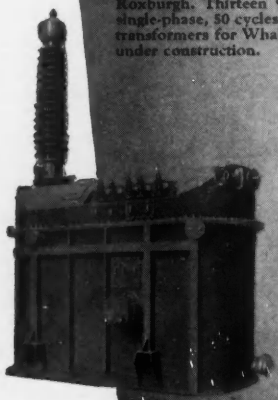
FINLAND Six 230,000 volt, three-phase Ferranti transformers have been ordered by the Imatra Power Company, Finland, for the Hikia Transforming Station and the Pyhäkoski Generating Station. Five are now in commission.

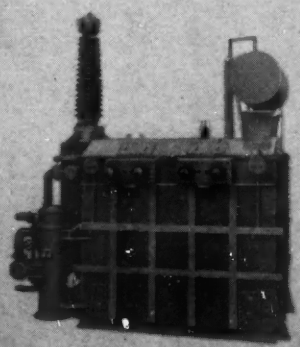


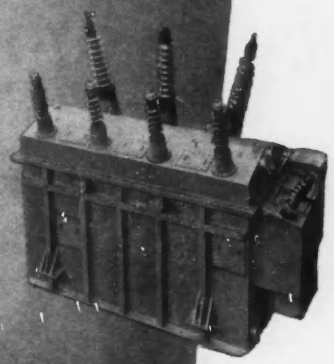
NEW ZEALAND Twenty-six Ferranti large power transformers have been ordered by the State Hydro-Electric Department of New Zealand. Thirteen 14,800 kVA, single-phase, 50 cycles, 11/220 kV transformers have already been supplied to Roxburgh. Thirteen 9,259 kVA, single-phase, 50 cycles, 11/220 kV transformers for Whakamaru are under construction.

CANADA Four 71,000 kVA, 301,400 volt single-phase Ferranti generator transformers and three 37,000 kVA, 275,000 volt step-down Ferranti transformers have been supplied to the Aluminum Company of Canada Limited for the Alcan Project at Kemano and Kitimat, British Columbia.

INDIA Three Ferranti 20,000 kVA, OFB, 3-phase, 50 cycles, 132/33.6 kV Transformers with on-load tap changing gear and two Ferranti 10,000 kVA, ON/OB, 3-phase, 50 cycles, 132/33 kV transformers with on-load tap changing gear have been supplied for the Damodar Valley Power Scheme in India.







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7.5	1.82	2.58	3.16	3.65	4.47
10	1.58	2.24	2.74	3.16	3.88
15	1.29	1.83	2.24	2.58	3.16
25	1.00	1.41	1.73	2.00	2.45
50	.707	1.00	1.23	1.41	1.73
75	.578	.818	1.00	1.15	1.41
100	.500	.707	.866	1.00	1.23
150	.408	.575	.707	.818	1.00
200	.354	.500	.612	.707	.866
350	.268	.378	.463	.535	.655
500	.224	.316	.388	.447	.548
1,000	.158	.224	.274	.316	.388
1,500	.129	.183	.224	.258	.316
2,500	.100	.141	.173	.200	.245
5,000	.071	.100	.123	.141	.173
7,500	—	.081	.100	.115	.141
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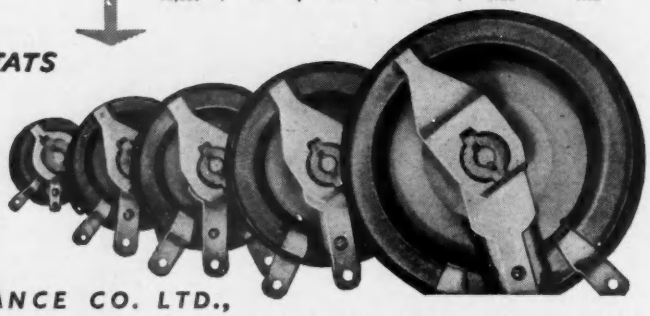

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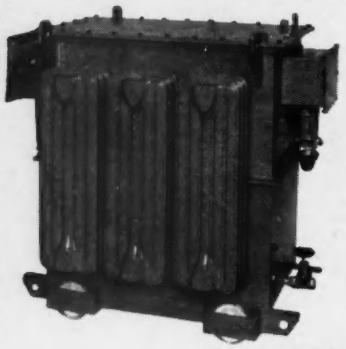

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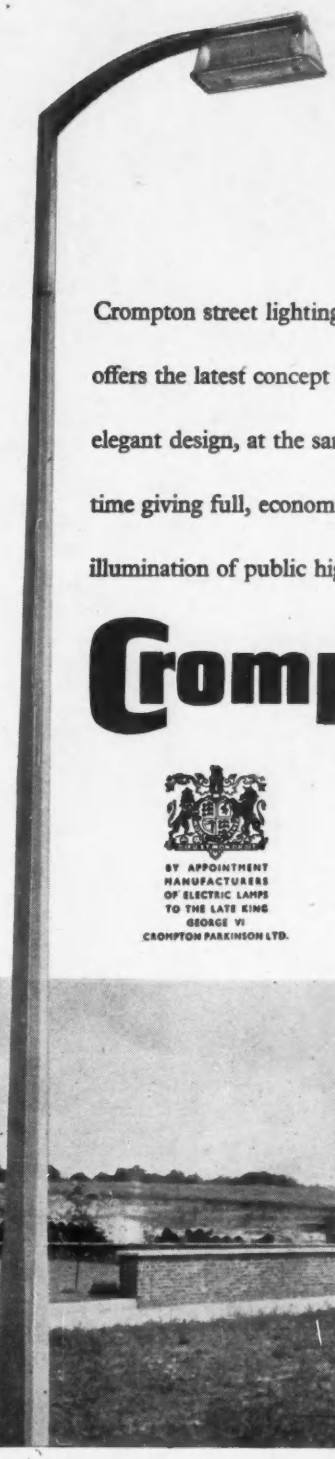

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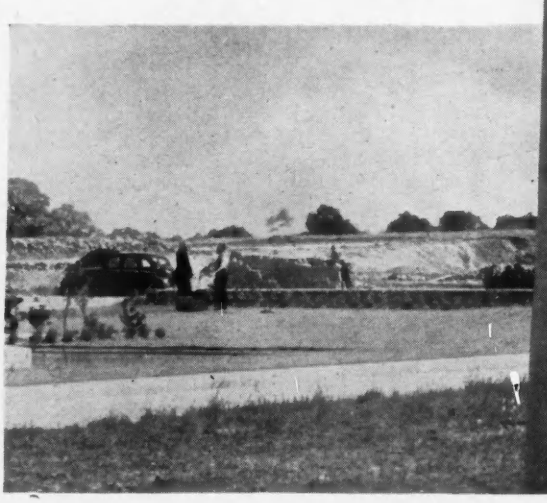

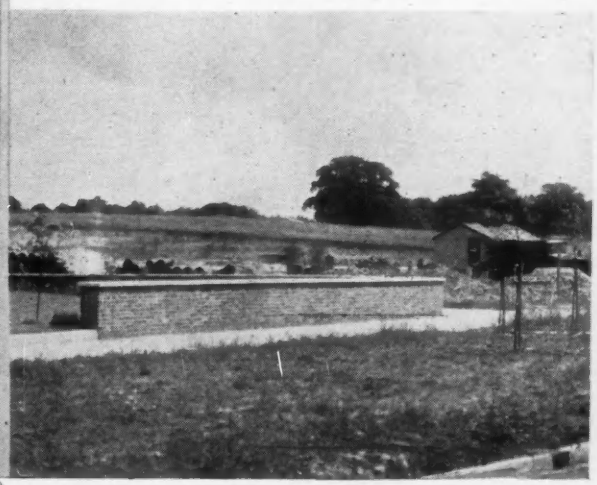

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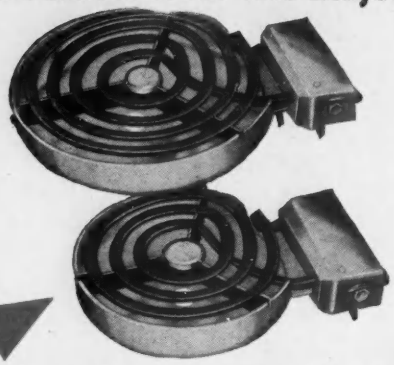

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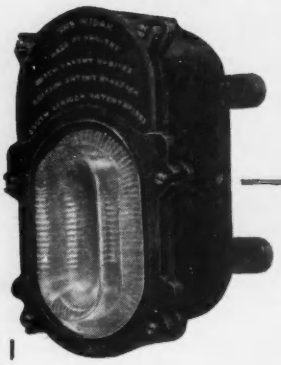
3 *Prismatic fittings are also made for B.S.I. box attachment in sizes up to 150 watts.*



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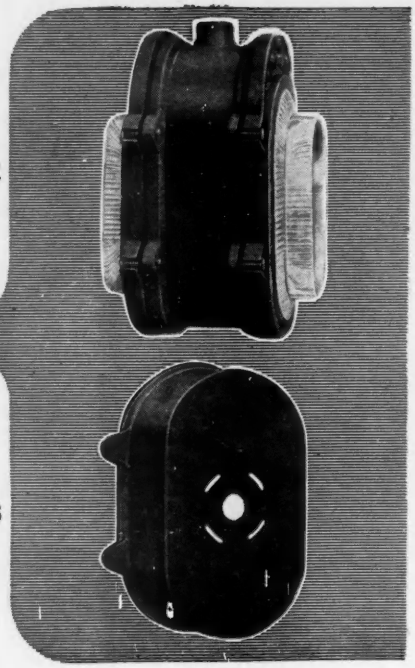

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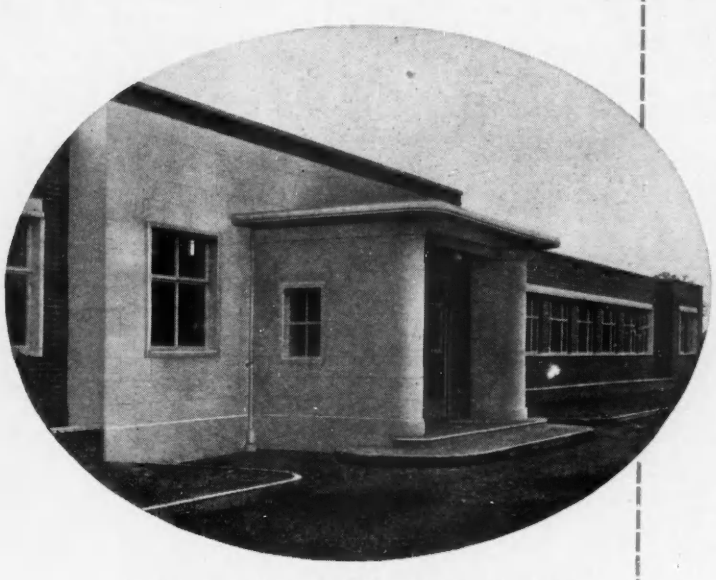

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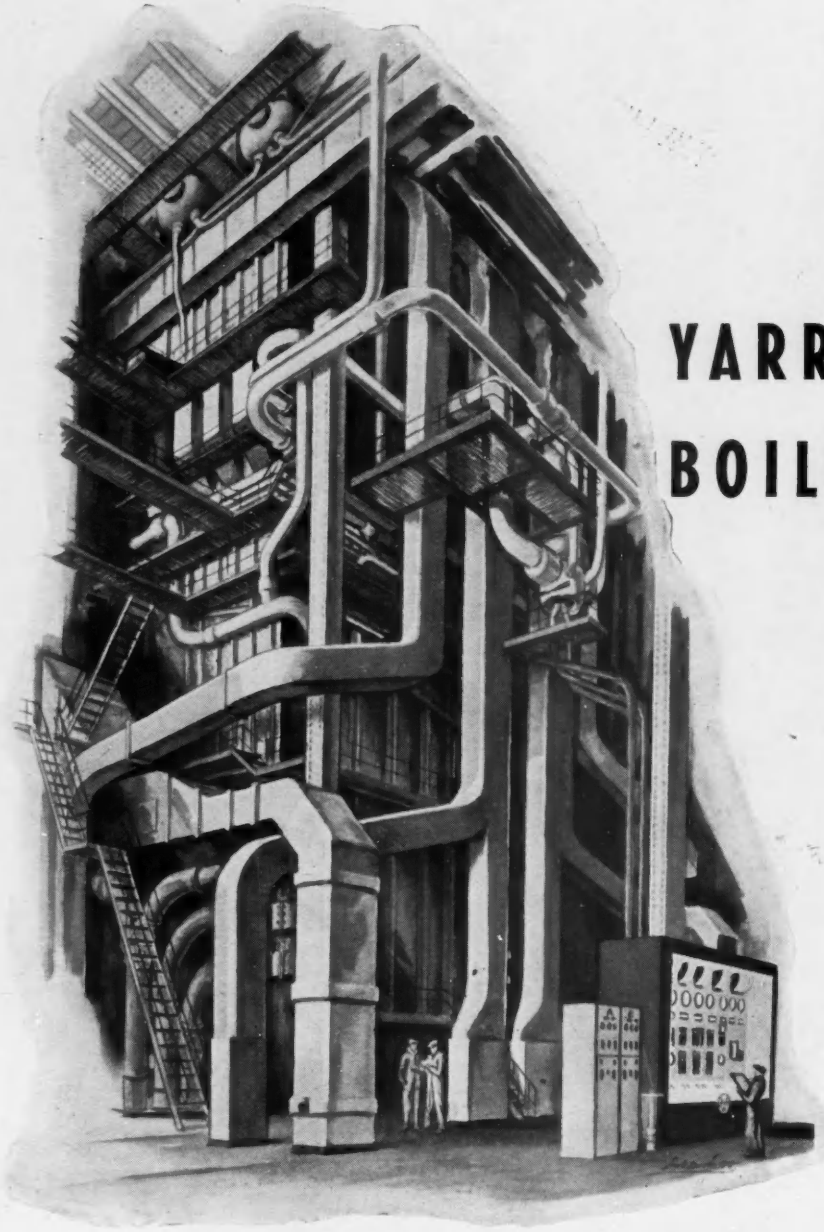

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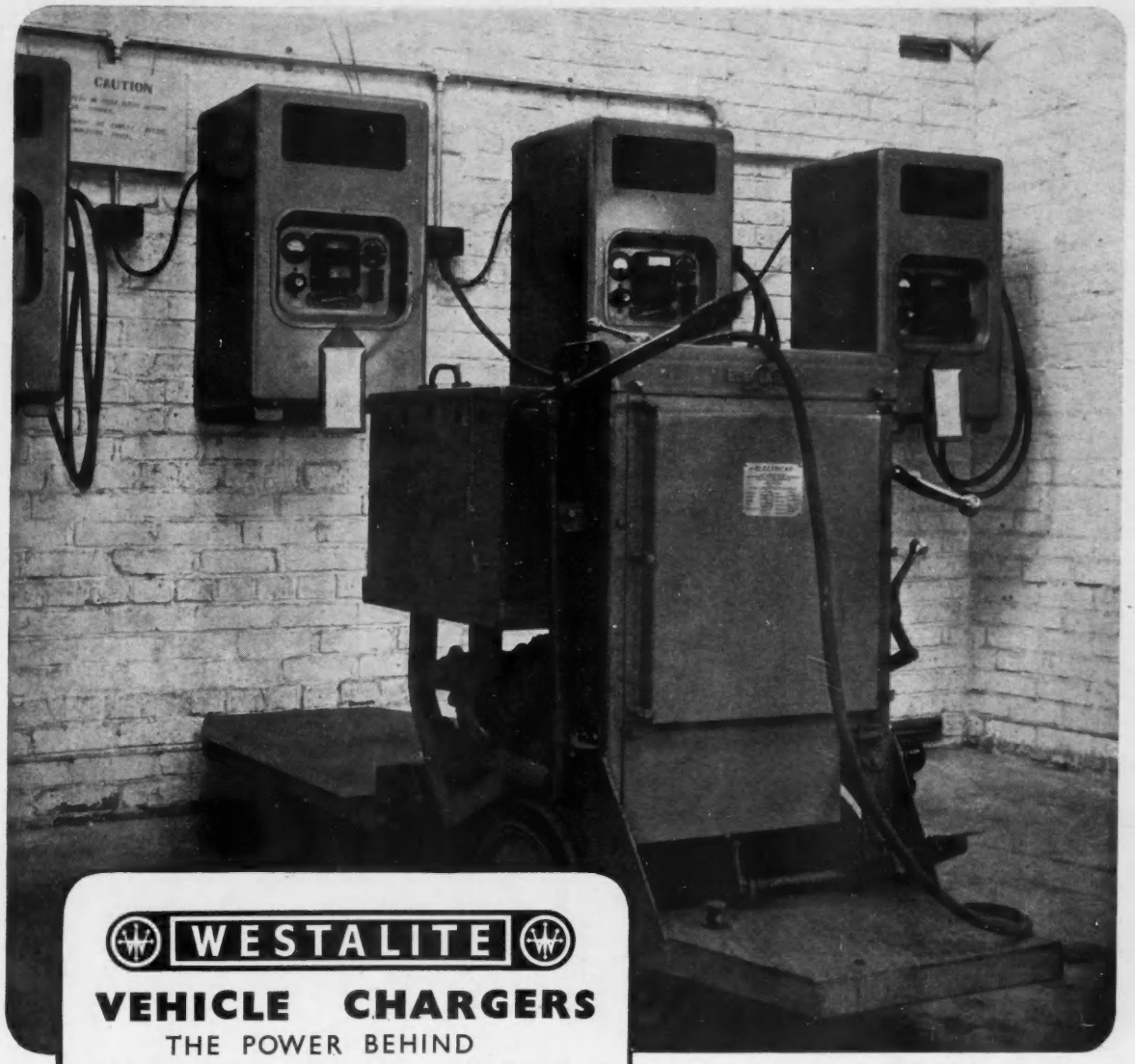

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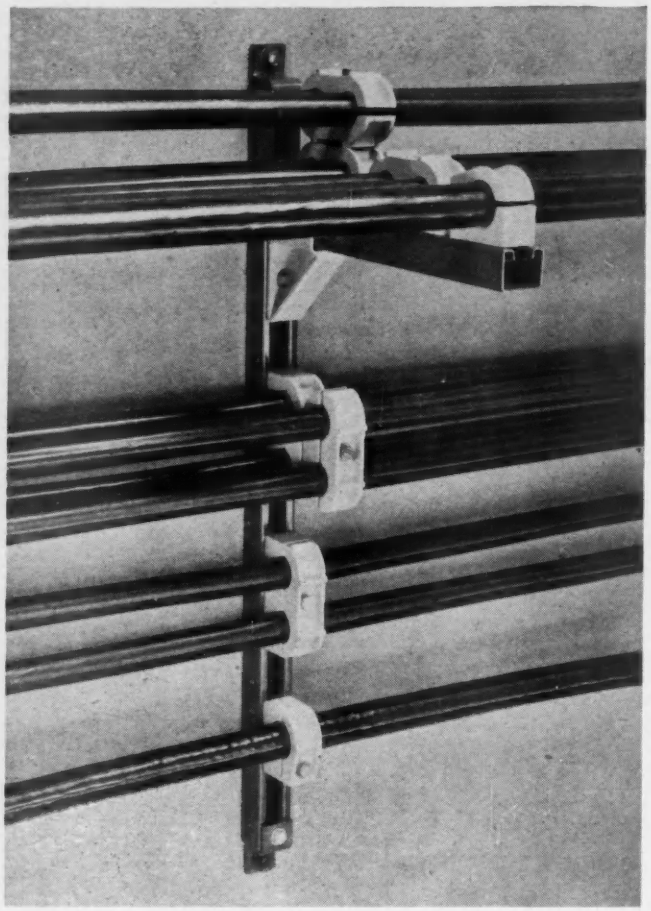

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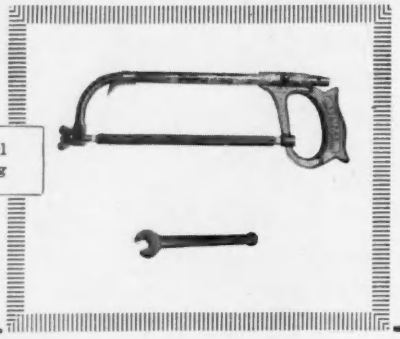

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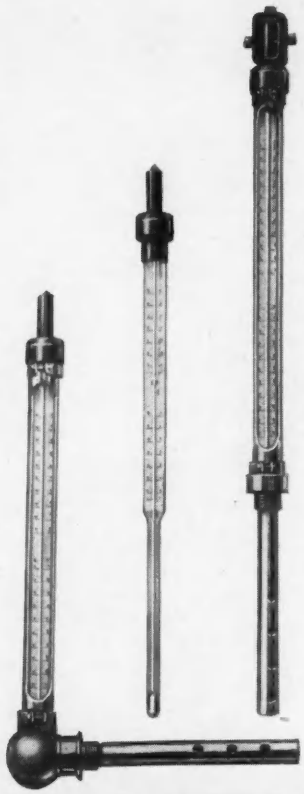

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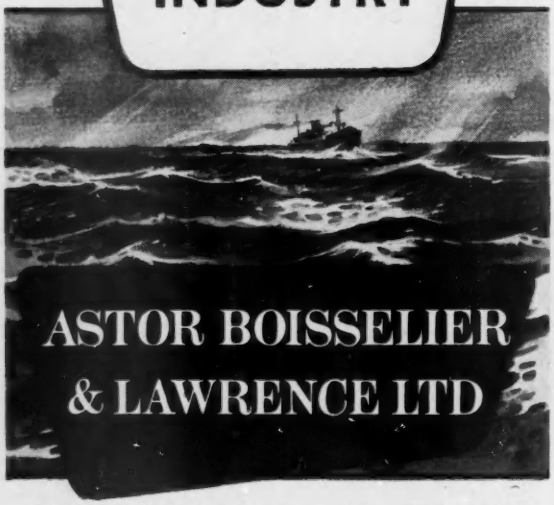

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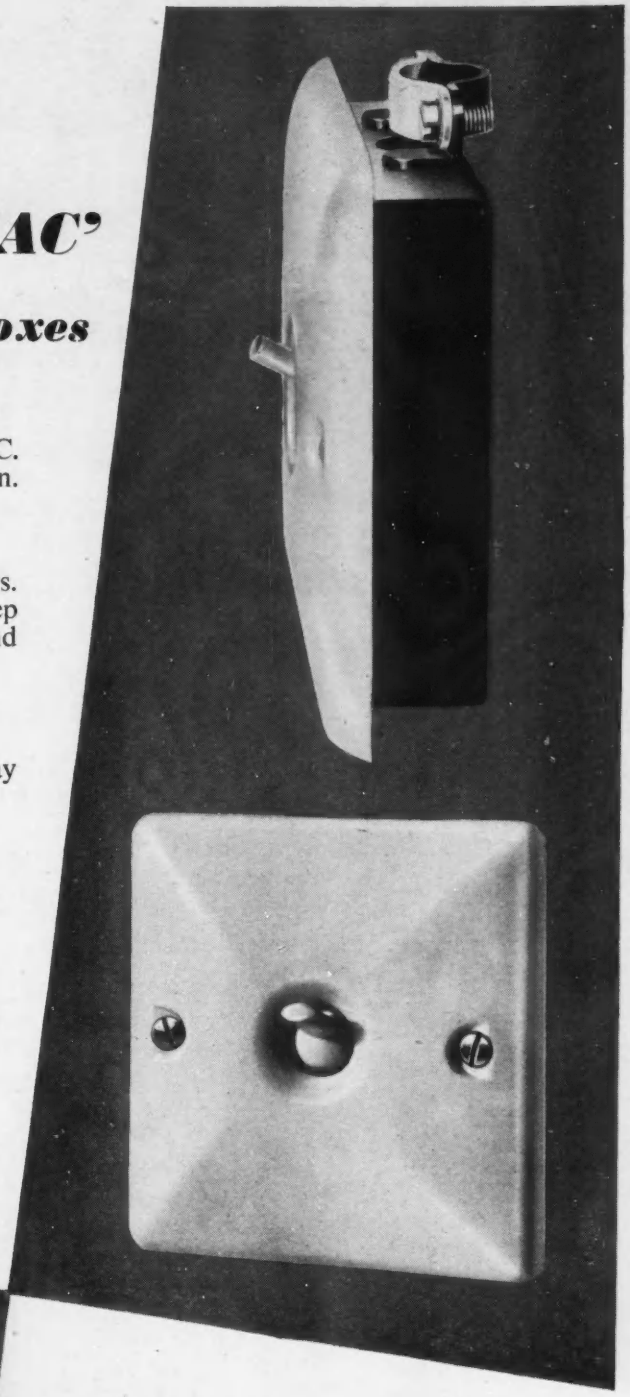

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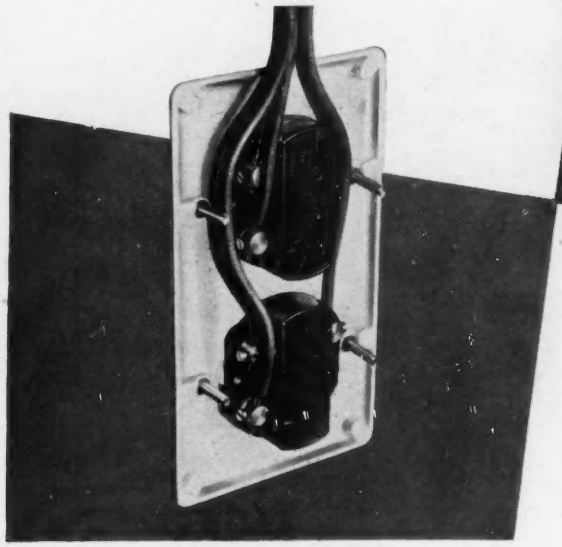

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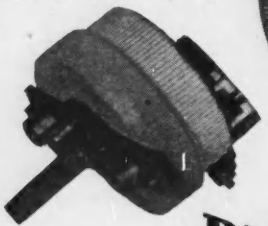

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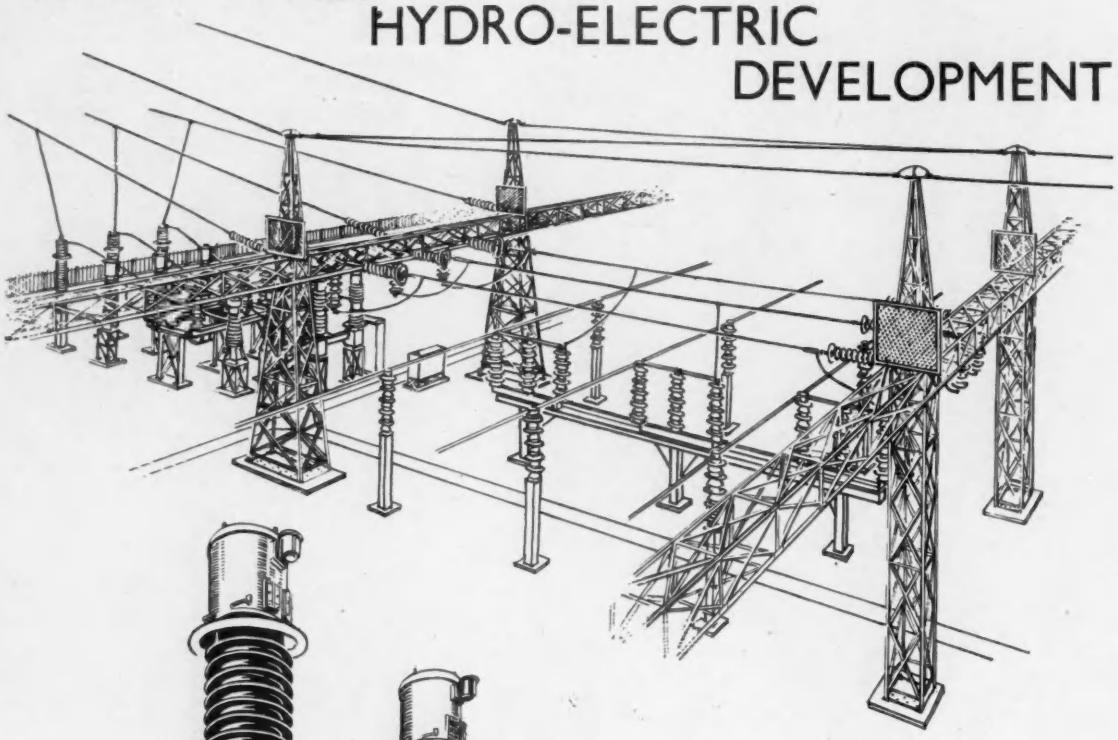
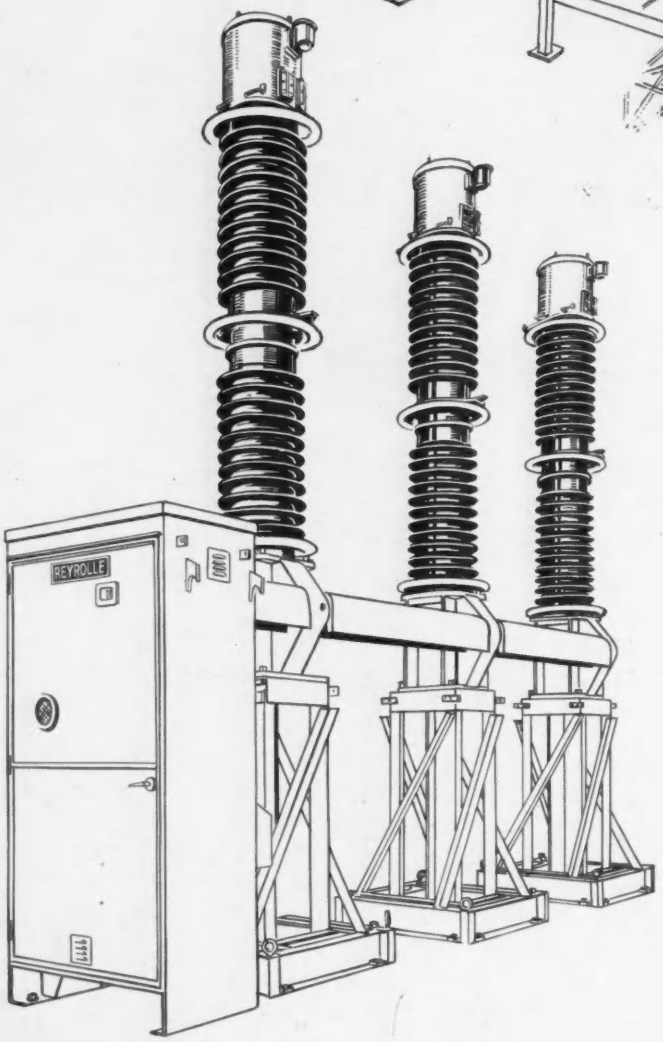


Owen Falls 132-kV Switchyard



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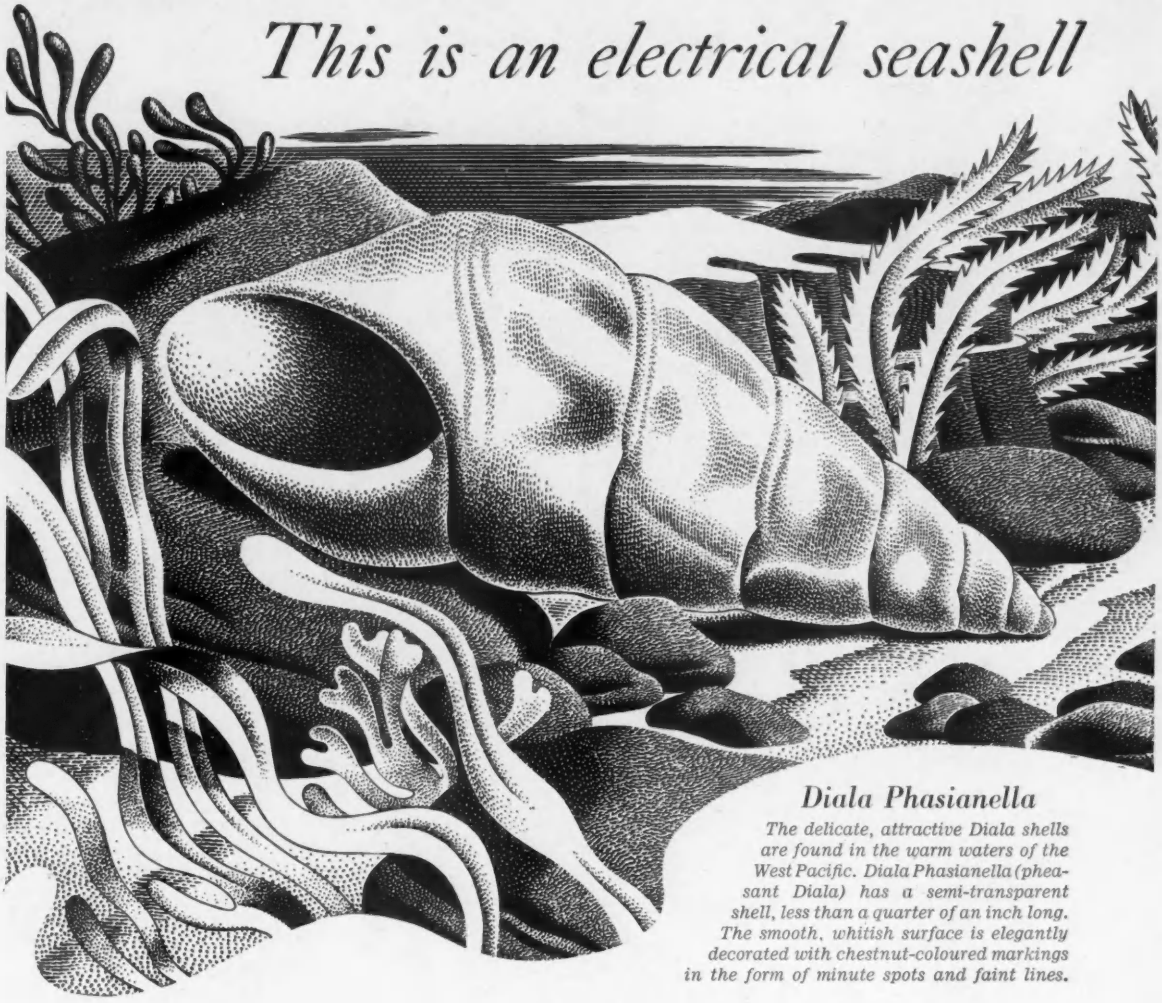

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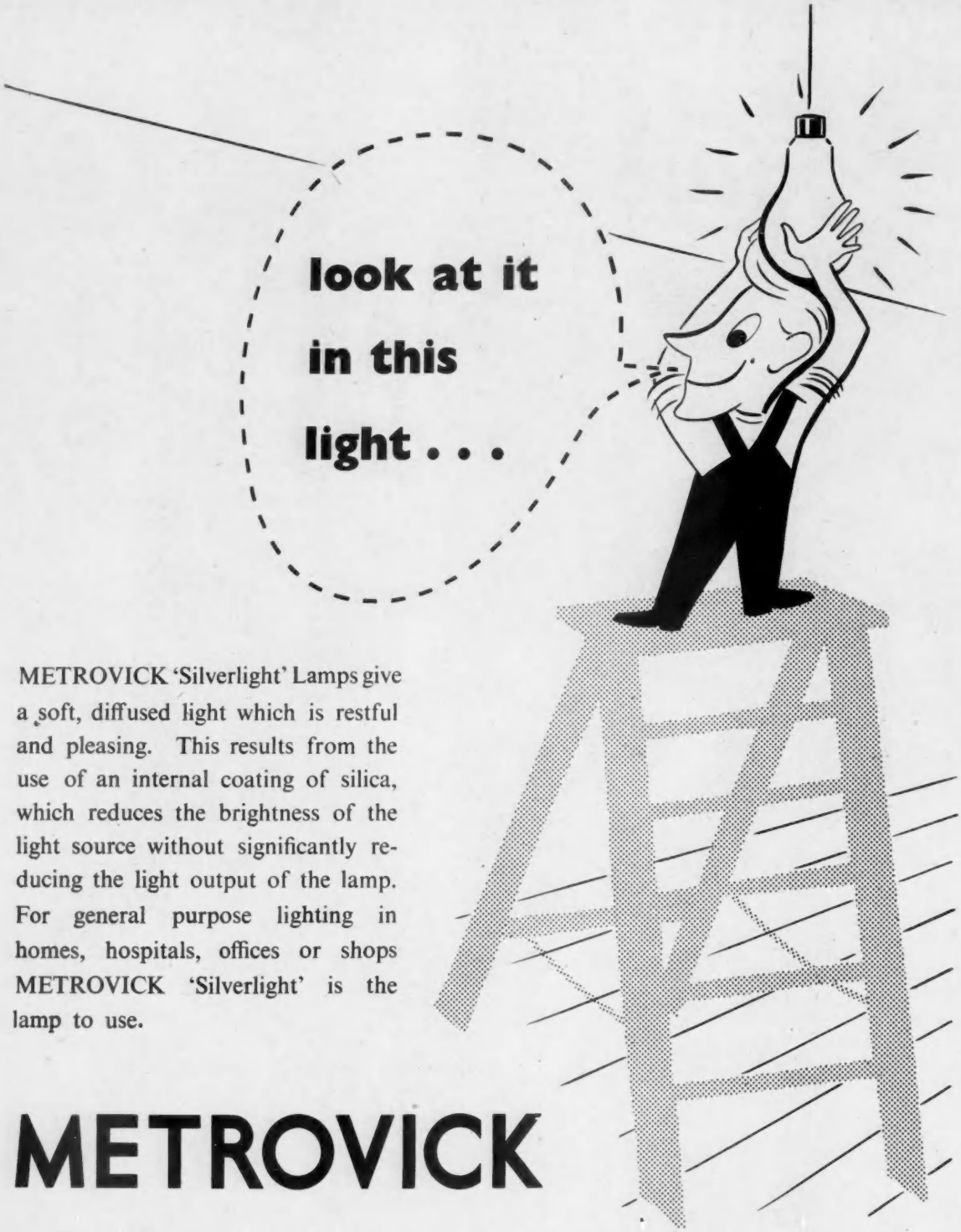

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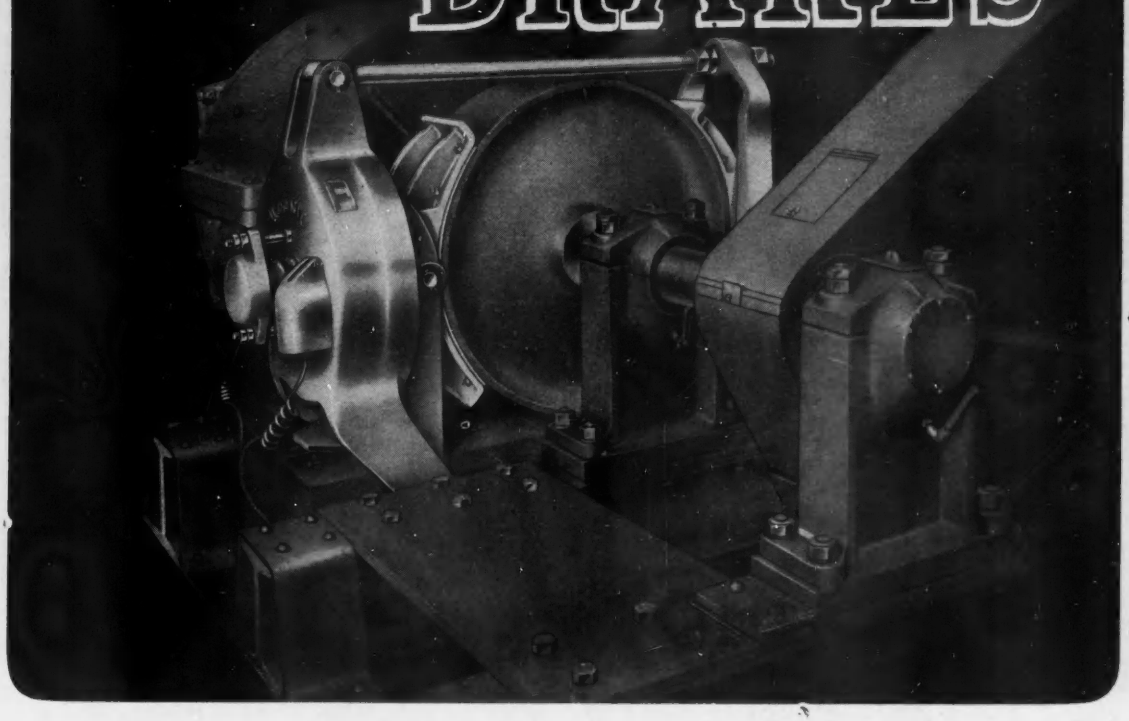

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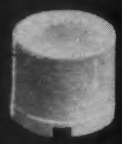

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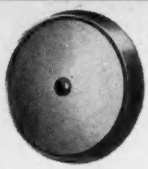

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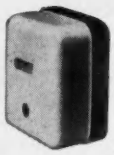

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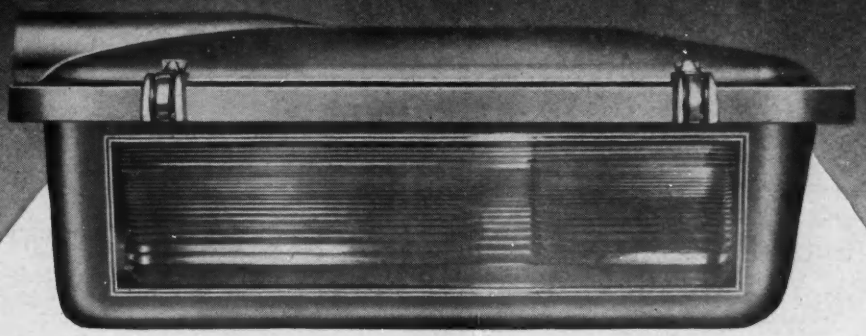

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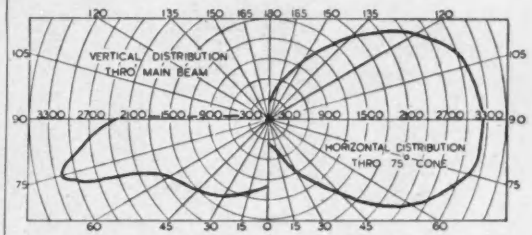

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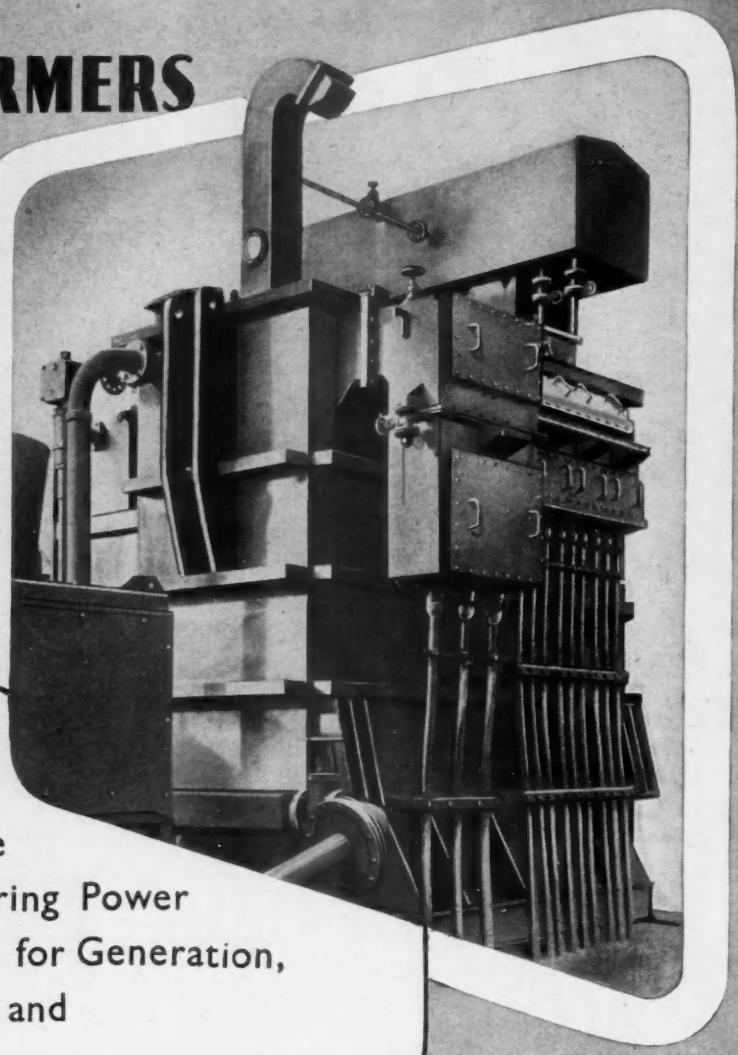

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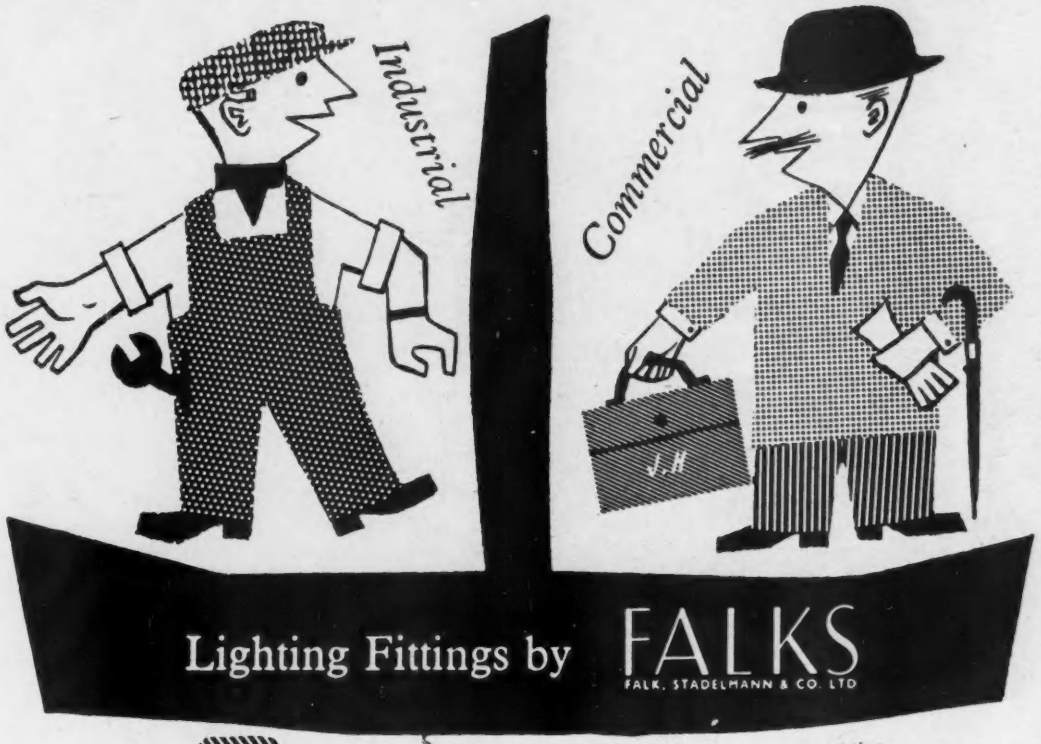

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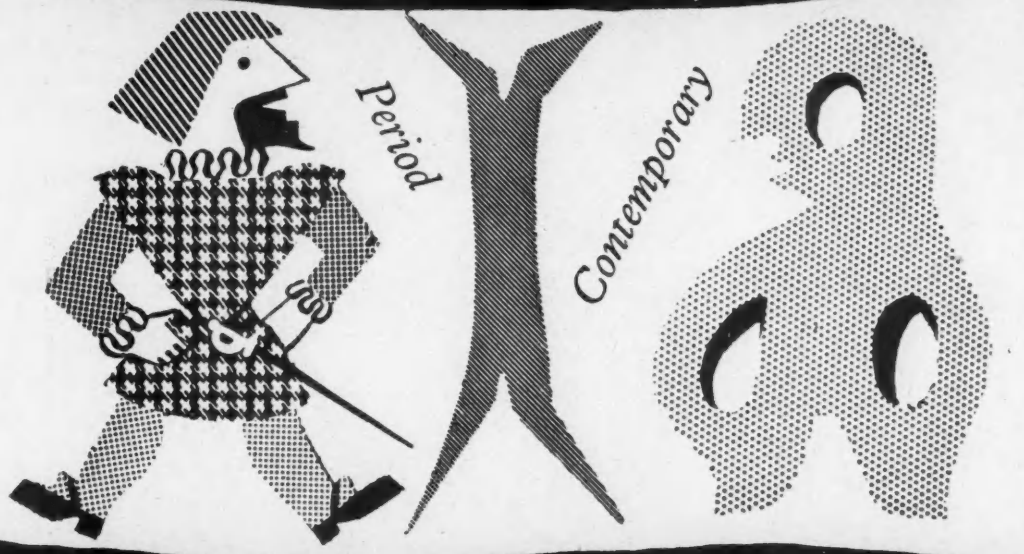

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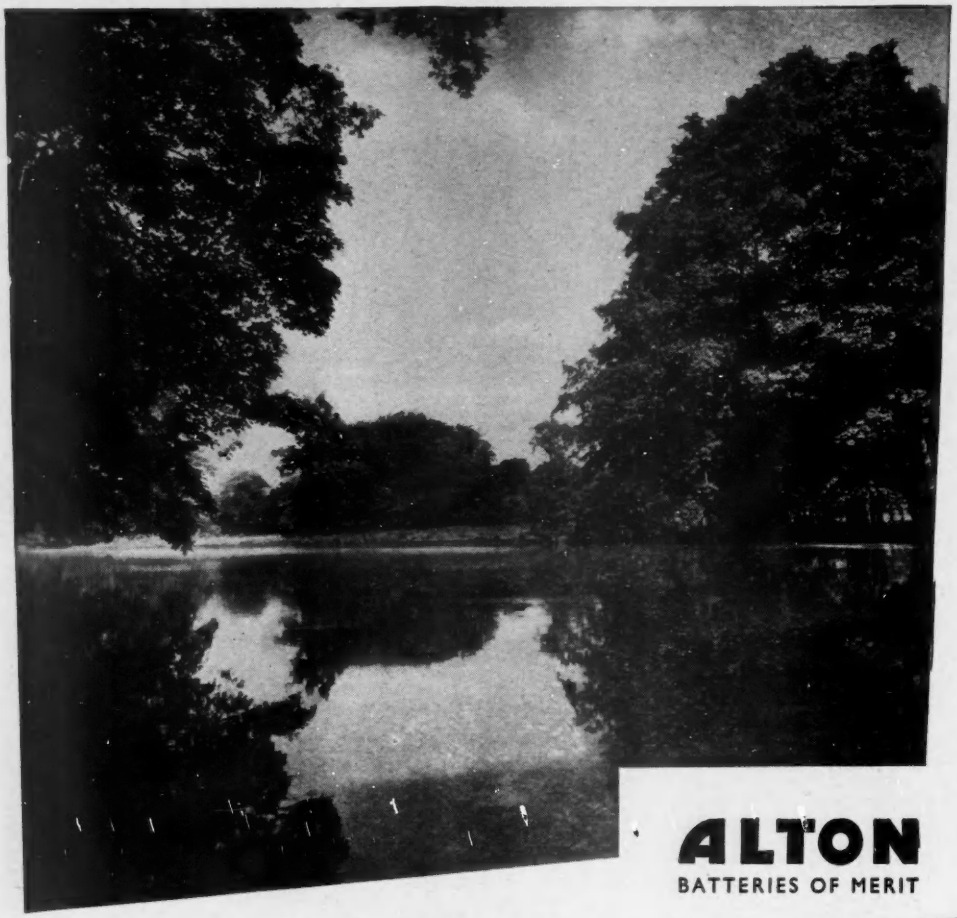

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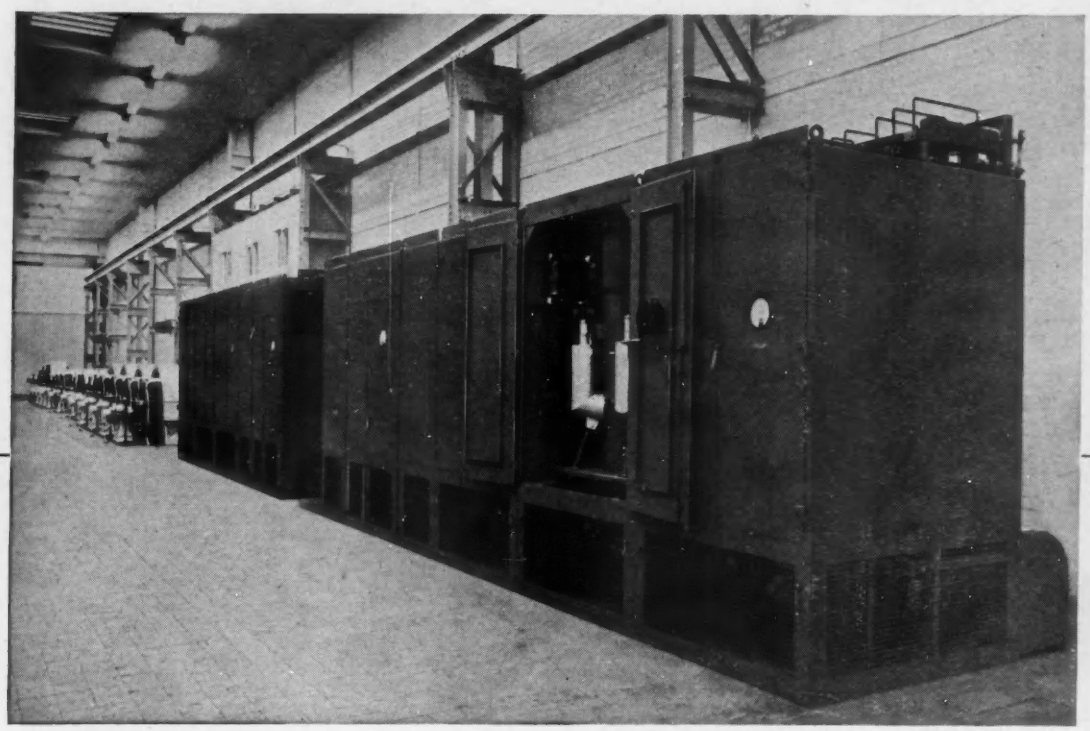

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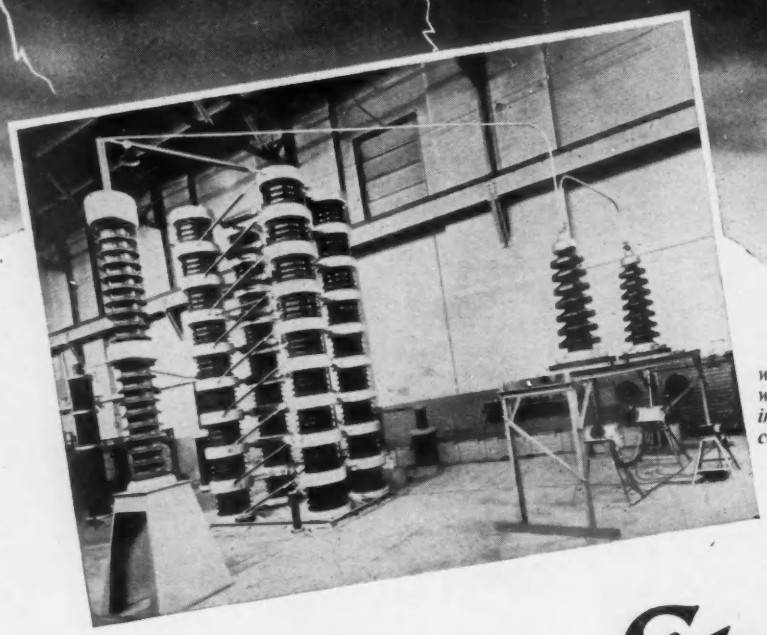

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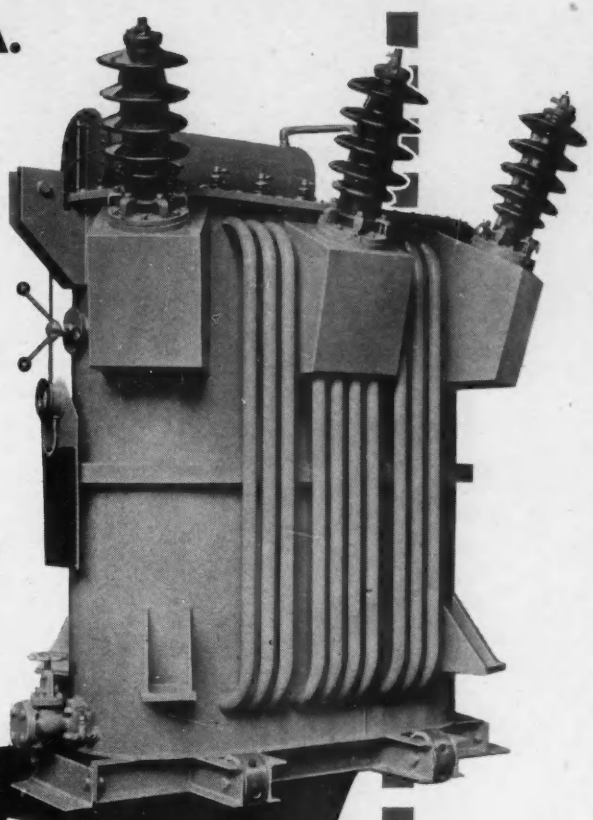

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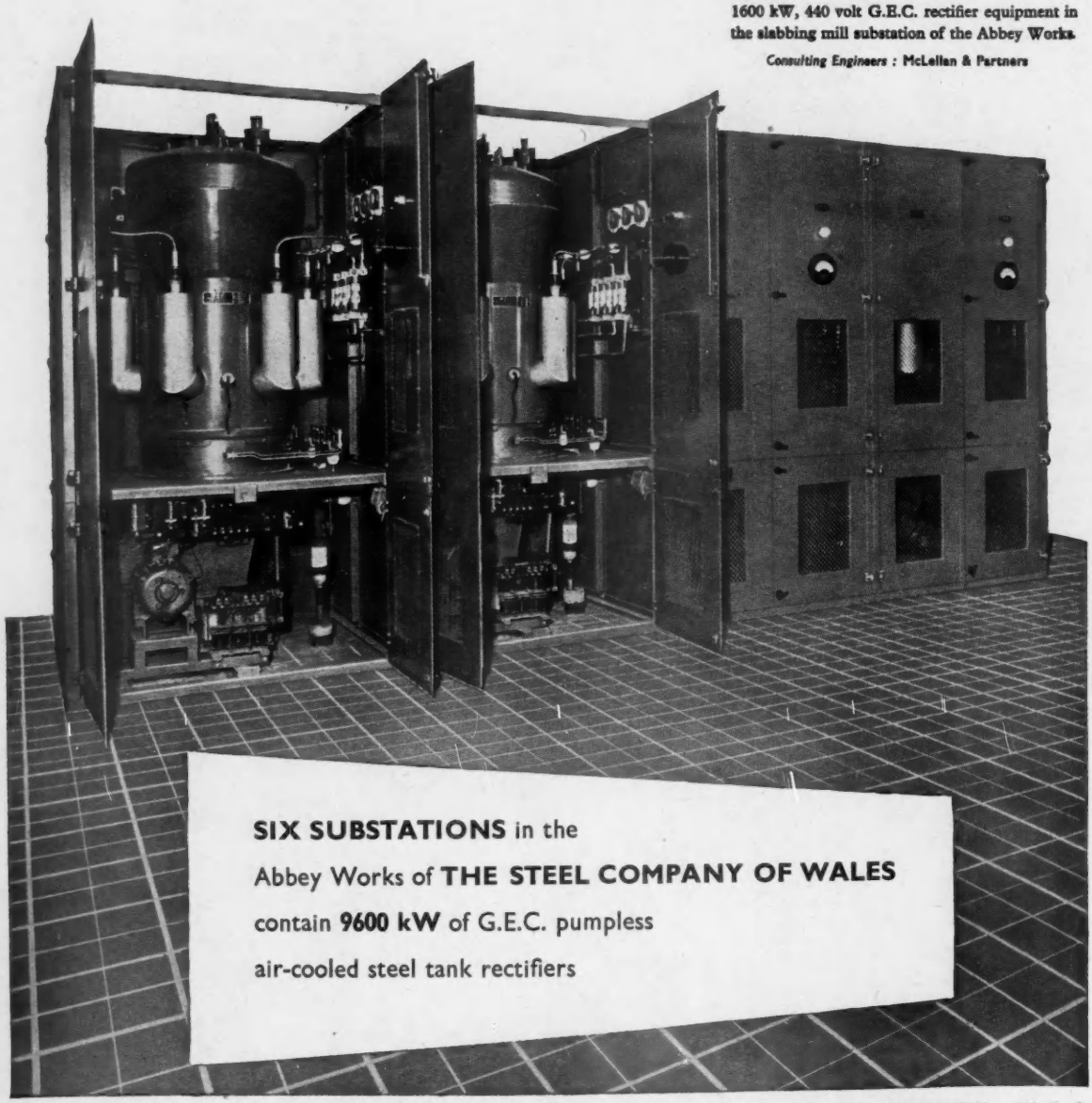

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ELECTRICAL TIMES

ESTABLISHED 1891

THURSDAY, 21 OCTOBER, 1954
Volume No. 126 Number 3285
REGISTERED AS A NEWSPAPER

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2.

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In This Issue

Road Traffic Control, *by E. Thorpe* 579
Yellow or White? 583
The Industry Surveyed 584
W. Australia Shows a Surplus 585
Accidents at Home 586
Notes on Wiring, *by Megohm* 587
New Colour Corrected M/V Lamp 588
Selling Motors to the States 588
Neutral Earthing in Power Transmission Systems, *by A. Saizmann*, DIPL.ING., A.M.I.E.E. 589
Rules for Unit Testing 592
Meter Engineering and Economics 593
New Materials in Engineering 593
Alkyd Moulding Materials 594
Emergency Exit Lighting 594
Ferranti's Edinburgh Laboratories Opened 595
Overseas News 596
Personalities in the Industry 598
New Literature 600
Problems and Practice in Engineering ... 601
Equipment for Industry 602
For the Electrical Trade 603
News of the Week 605
Electric Supply News 609
Company Activities 610
Commercial Information 611
Classified Advertisements 57
Index to Advertisers 64

SUBSCRIPTION RATES

United Kingdom and Overseas £2. 10s. 0d. per annum. Canada $7.50. U.S.A. $7.50 per annum. Subscriptions are payable in advance and may commence with any issue throughout the year. Overseas subscriptions may be paid to The Electrical Times Limited by banker's draft, cheque or international money order. Single copies price 9d. each.

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DANGER THROUGH EARTHING

Many thousands of words are printed every year to remind electrical engineers of the dangers introduced when earthing is neglected: and yet, at times this same earthing can become an important factor in causing a fatal accident. There is a reminder of this paradox in the latest summary of fatal domestic electrical accidents, which reached us from the Home Office last week. As in previous years, several people received fatal shocks through completing a circuit between live metal and an appliance frame which had been deliberately earthed in an otherwise earth-free situation, in a mistaken attempt to comply with good practice. The tragic accident of a lady who attempted to replace a nut that had fallen from a kettle connector without regard to the golden rule "switch off" may serve as an example. She died because in grasping the connector she was touching the associated earth continuity clips so that when the screw held in her other hand touched live metal, her body was across the mains. This happened in a living room, an earth-free situation: the earth clips need not have been connected to the installation earthing system. Had it been left earth-free her foolhardiness would not have been punished. In this and similar accidents, there is a reminder of the too-frequently neglected exemption to I.E.E. Wiring Regulation 1001, which in general permits earth contact tubes in three-pin socket-outlets to remain disconnected from the earth continuity conductor serving them when an earth-free situation is involved. Despite such accidents, domestic electricity is astonishingly safe: some 35 fatal accidents last year with 17m consumers. Nevertheless, preserving truly earth-free situations can make it safer still.

GAS TAKES A FALL

Once more this year the Gas Council, in its annual report, strengthens its courage with the thought that, "When tenants in new houses are given freedom of choice, their preference for gas remains undiminished." This frequently repeated claim does not imply all that it suggests: many families moving into new dwellings already possess gas cookers, and must perforce use them even if they would like to change to electricity. The atmosphere of expansion suggested by such claims is, furthermore, not supported by the industry's statistics. There was less gas sold in 1953-54 than in the previous year, despite a 3% increase in industrial sales. A drop of 1·7% in domestic and commercial sales outbalanced this; it compares with the increase of 3·9% in the electricity industry's sales to the same consumer categories. Active as ever in the domestic field, however, the Gas Boards have made a new

effort by departing from their traditional policy of keeping to themselves the sale of gas appliances: ironmongers and department stores are being recruited to boost sales of cookers, water heaters and the like. By such means, and with the aid of relaxations in hire purchase restrictions, sales of water heaters on hire purchase were nearly quadrupled, while there was a 20% increase in hire purchase sales of cookers. Finally, the report suggests a cautious tendency to back prospects both ways. The Central Guarantee fund set up as a reserve to cover difficulties in paying interest includes some £608,250 invested in British Electricity stock.

UNIT TESTING OF SWITCHGEAR

The high breaking capacities required on modern extra-high voltage switchgear have now outstripped the facilities available at most testing stations for full-scale testing. Although technically it would not be impossible to build a station with a capacity sufficient to give 10,000 MVA or above, the costs involved put such a proposition out of the question. For some time, therefore, work has been carried out to develop a system of "unit" testing for the multi-break circuit-breakers now generally used, which would be consistent within itself, and which would truly represent the performance of the breaker as a whole. The possibility of such unit testing has long been attractive but has always presented difficulties. These are mainly concerned in the establishment of similar breaking duties between similar units, and in ensuring that all parameters affecting performance shall be independent of each other in the units as far as possible during operation. In addition, the determination of the correct unit recovery voltage has presented a major problem. The publication of the Association of Short-Circuit Testing Authorities' booklet, ASTA No. 15 which contains rules for this method of testing circuit-breakers both for making and breaking capacity is, therefore, important, and it is particularly significant that the I.E.C. is to publish its own regulations which it is expected will be similar to the ASTA rules in all main features. The provision of such an international standard should go a long way to eliminating the discrepancies which have hitherto existed in methods of testing and rating of switchgear manufactured in different countries.

ELECTRIFICATION ON A SLOW LINE

Railway electrification receives much attention in the Report of the British Transport Commission for 1953, which appeared last week. Yet the story told will bring but moderate satisfaction to enthusiasts who see in such development the answer to many problems of both transport economics and coal supply. Main line electrification is hardly considered, while for lengthy cross-country routes, the present accent is on diesel multiple-unit passenger train-sets as offering in many respects "the benefits of electrification without the need for heavy capital expenditure upon fixed equipment or substantial engineering works." For heavy traffic density urban areas, however, there can be no gainsaying the benefits that flow from electrification, and there is news in the report of plans for several extensions to the London complex of electrified routes to the suburbs and beyond. Notable amongst the prospects discussed are the suburban lines from King's Cross and a new underground railway striking across London from South-West to North-East. Yet these remain paper prospects only, for the real story of the railways is told in the Commission's emphasis that the £68m of capital expenditure during 1953 has done little more than maintain the existing scope of the undertaking with little addition to plant and property. It is the next few years which will see if the prospects turn at last to probabilities, with the release of capital for expenditure on potentially remunerative modernisation.

ELECTRONICS FOR SCOTLAND

As an insurance against trade recession in areas of heavy industry, it has been the Government's policy to encourage the admixture of lighter engineering groups to provide a diversity of manufacturing interest so that in the event of one industry suffering a slump, the locality is better able to withstand the impact. This building up of new industries in areas where no pool of trained operatives and technical staff exists, presents special problems. One solution is to set up an establishment to act as a nucleus for the training of staff and for technological guidance to neighbouring firms. It is such a function that the new Ferranti laboratories at Edinburgh will fulfill in addition to the primary purpose of defence development and research. At the same time, the centre will provide facilities for precision measurement and will be in a position to undertake work on a similar basis to that performed in England by the existing Ministry of Supply Research Establishments. The new scheme has the blessing of the Ministry of Supply and the Admiralty, who have given full co-operation. It is hoped, however, that this project will go beyond the immediate objective and lead to the establishment of a substantial and active electronics industry in Scotland.

MAIL-ORDER MOTORS

Mail-order in the U.S.A. is a major business with few limits on the range of goods; it serves a market far more extensive than that in this country. Even so, it is startling to read in a recent Board of Trade market survey, that in the extensive business of selling electric motors to farms and homes, the leading mail order houses dominate the field, even going so far as to market motors rated up to 5 h.p. under their own brand name. One had supposed that selling motors was too technical an undertaking to lend itself readily to the mail-order system. Yet there is opportunity as well as interest in this American sales fact. Mail-order houses sell largely on their reputation: to their regular customers, their willingness to offer a product is a guarantee of its quality. Such confidence is worth capturing when the inherent distrust of a foreign-made product has to be fought. If they will sponsor an imported machine, customer resistance is at once lessened. British motor manufacturers seeking to increase still further exports to the States, which have doubled in two years, may find this unfamiliar retail outlet worthy of consideration. With their known quality and possible price advantages they should stand a reasonable chance of persuading existing mail-order businesses to do business.

Meteor

ROAD TRAFFIC CONTROL

Vehicle actuated signalling provides flexibility and safety for modern conditions

By E. THORPE*

Part One

THE first vehicle-actuated road signal system in this country was installed at the junction of Cornhill and Bishopsgate some 22 years ago, the equipment being designed, manufactured and installed by Automatic Telephone and Electric Co., Ltd. Outwardly it differed little from other signal systems already in use in that indications were given by the familiar red, green and amber light signals, the only apparent dissimilarity being the inclusion of a form of rubber mat set into the roadway in each approach to the junction. In performance, however, it was vastly superior. The long needless delays so commonly experienced at other signalled junctions working on the "fixed time" basis were noticeably absent, particularly during light traffic periods.

The improved performance was soon appreciated by both the general public and interested authorities, and further installations rapidly appeared. Today, at over 2,000 junctions and dangerous "bottlenecks," vehicle-actuated signals demonstrate their ability to provide positive, reliable and safe control of traffic under an infinite variety of circumstances. They enjoy the respect and confidence of the vast majority of all road users and play an increasingly effective part in the battle against traffic congestion, a feature of modern civilisation which threatens to bring the complicated transport systems of our towns and cities almost to a standstill.

Basic Equipment

A vehicle-actuated system comprises three main components, vehicle detectors, signal lanterns, and the controller mechanism, all equipment being robustly constructed to provide continuous 24-hour service under exposed climatic conditions. Three, eight and twelve core 3/·029 v.r.i. lead covered and armoured cable is used to connect signals and detectors to the controller. It is buried directly in the earth under pavements, and fed through 2 in. "Everite" cement asbestos conduit under carriageways. The vehicle detector provides the controlling mechanism with an accurate "picture" of all vehicles entering the controlled area and, based on the information received, the mechanism provides right-of-way periods to each particular movement in relation to the traffic density.

The "Electro-matic" vehicle-actuated detector is a pneumatic device of high efficiency and durability. It is sensitive to the lightest of bicycles and yet robust enough to withstand the impact of heavy goods vehicles, including the strain occasioned during rapid acceleration or deceleration. It is able to discriminate between vehicles entering and leaving the junction and also automatically neutralises the effect of a vehicle parked on its surface. Under such circumstances it provides for continued normal operation on the area free from obstruction.

Fundamentally the road unit of the detector consists of two rubber air tubes of special section suitably housed in a formed mild steel framework of 2 ft unit length,

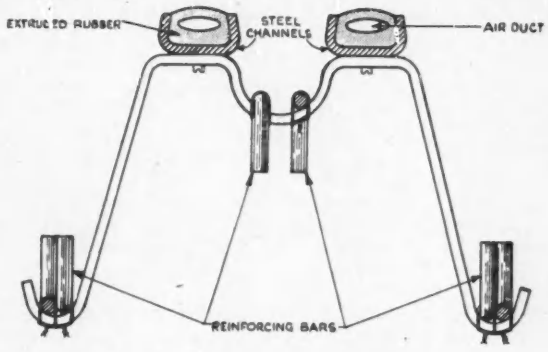


Fig. 2. Cross-sectional view of the flat strip type directional vehicle detector Fig. 1. (heading illustration) shows a view of Corbridge Bridge, Northumberland where these detectors are employed

*The author is with the Automatic Telephone and Electric Co., Ltd.

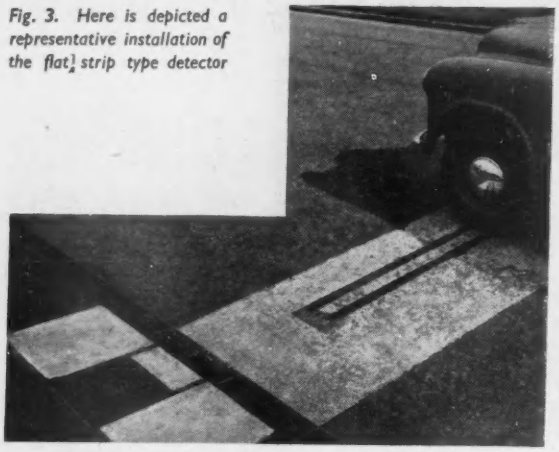


Fig. 3. Here is depicted a representative installation of the flat strip type detector

available lengths being from 4 to 16 ft in steps of 2 ft. Fig. 2 illustrates a section view of the road unit and Fig. 3 a typical detector installation in its normal bed of concrete, together with the pavement box which houses the associated pneumatic contactors. Connection between tubes and contactors is made with ½ in. bore galvanised steel tube, the complete air system being shown diagramatically in Fig. 4. From this view it will be seen that the exhaust side of the contactor is fed into an expansion chamber and that the air system is therefore completely closed. This ensures continued efficiency of operation even when the system is completely surrounded by water, a condition which is by no means unusual.

Pneumatic Contactor

The contactor itself (Fig. 5) is a small moulded bakelite unit with a freely suspended rubber diaphragm across its centre. The diaphragm is pierced with a small hole which functions as an equalising leak. Normally the air pressure on either side of the diaphragm is equal and the contacts are open. When, however, the detector tube is depressed by a vehicle the air pressure on the inlet side is increased and the diaphragm flexes towards the low pressure side causing the contacts to make, and via the connection leads, conveys information to the controller of the passage of a vehicle. The function of the expansion chamber under this form of operation is to exert a certain amount of back pressure to prevent undue flexing of the diaphragm, especially when extremely heavy vehicles are being detected.

Should a vehicle actually "park" on the detector tube, the increased air pressure in the latter will produce a contact operation as before, but eventually will leak through the equalising leak into the expansion chamber. When the pressures equalise, the diaphragm returns to normal, and because a vehicle wheel cannot completely close the air tube, the free length of detector can be operated in the normal manner.

By means of a simple switching circuit shown in Fig. 6, the two air tubes are used to provide directional indication of the passage of a vehicle, the sequence of actuation being the determining factor. This particular feature ensures that vehicles leaving the junction are not falsely recorded as entering vehicles.

Referring to Fig. 6, it will be seen that a vehicle approaching the junction will operate the pneumatic contactors in the sequence A—B and that when contactor A is operated, a pulse is sent into the controller via contact B1 normal. The subsequent operation of contactor B under these circumstances is negative. If, however, the vehicle is leaving the junction, the contactors operate in the reverse sequence B—A. Contactor B operating first operates relay B which opens the controller circuit at B1 and neutralises the subsequent pulse from contactor A. Contact B2 short-circuits winding AB and provides a slow release feature in order to cover the transit time of the vehicle between the detector tubes. This time is of the order of 61 milliseconds at 5 m.p.h. and 10 milliseconds at 30 m.p.h.

Controller Unit

The controller unit is virtually the "brain," the duty of which is to assimilate the information supplied by the detectors and, by utilising the signal lanterns, give clear and unmistakable indications to the detected vehicles to produce safe and flexible control with a minimum of waiting time. A typical "Electro-matic" control unit, complete with outer case, is shown in Fig. 7. The controller operates directly off a.c. mains supply and consists essentially of a solenoid operated camshaft mechanism which provides cyclic appearance of the necessary intervals and is capable of switching 22 circuits simultaneously, 2 timing circuits and a number of a.c. operated relays proportionate to the phases and facilities required. These relays are capable

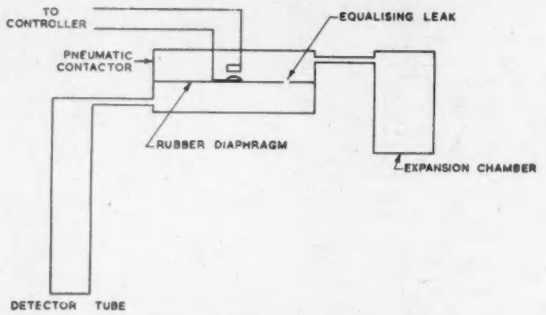


Fig. 4. Schematic diagram indicating the operation of the air system of the vehicle detector

of switching up to 8 circuits with contact ratings up to 5 amp at 250 V a.c. A typical relay is shown in Fig. 8.

Principles of Control

The basic principles of control can best be appreciated by consideration of a straightforward right angle crossover junction employing two movements or "phases" as shown in Fig. 9. It is assumed that turning traffic, particularly the more awkward right-turning vehicles, is insufficiently heavy to justify special treatment and can be safely absorbed in the major through movements.

In the complete absence of traffic, the signals remain in their last used condition, that is, green showing in the direction of the last vehicle to pass through the junction. If now a vehicle approaches the red signal, operation of the vehicle detector originates a "demand" to the controller which immediately initiates a change to green via red/amber, the other approach simultaneously changing from green to red via amber. The green is then maintained for a predetermined minimum period to permit the vehicle to completely clear the intersection. At the end of this period, right-of-way is again available on demand. Should the next vehicle approach in the same direction, operation of the detector will be translated by the controller into a request for extension of right-of-way time or, as it is normally termed, a "vehicle extension." This extension is of sufficient duration to cover safe traverse of the junction.

Such extensions can carry on indefinitely, providing no vehicle is detected in the opposing approaches, but once this occurs the controller seeks an opportunity to change right-of-way in the latter vehicle's favour in one of two ways. Firstly, a change will occur if a gap which is greater than the vehicle extension time occurs between vehicles on the running phase, or secondly, in the event of no such gap arising, a forced change will eventually occur at the expiration of a predetermined maximum running time. Such a forced termination of the phase may well leave vehicles in between the stop line and the detector, but these are not forgotten, the maximum timer automatically inserts a "revertive call" which results in the right-of-way returning to the phase in question as soon as opposing traffic permits.

Heavy Traffic Conditions

Should traffic on both roads be continuous and heavy, each phase will be extended to the maximum and the controller under these circumstances would, in effect, operate on a fixed time cycle. This, however, is seldom the case in practice because the traffic loading varies from minute to minute and the cycle time, which is equivalent to one appearance of each phase, varies accordingly.

The minimum green period already referred to as being provided when a phase first obtains right-of-way actually comprises two separate timed intervals one of which is the normal vehicle extension time, the other being known as the initial interval. This latter period is provided to enable stationary vehicles to start up and clear the junction, its duration being related to the vehicle storage space between detector and stop line.

A wide range of timings are provided for each interval and are readily adjustable by handset knobs to suit the requirements of individual intersections.

Timing System

The basic timing system which is energised by a d.c. supply is shown in Fig. 10 (a) and will be seen to consist of a variable resistance VR, a capacitor C, a neon tube F, and a d.c. relay P. Capacitor C charges at a rate dependent on the value of VR, the rate of charging being inversely proportional to the resistance VR. When the potential across C is sufficient to ionise the gas in the neon tube F, flash over occurs and the capacitor C discharges via the neon tube in series with relay P, causing a momentary operation of F. With nominal values of C=5 microfarad, VR=200,000 ohms, flash voltage of tube=260 V and an applied voltage=412 V, one second will elapse between the application of the d.c. supply and the momentary operation or pulse of relay P.

This basic timing circuit is used to time all intervals regulated by the controller and Fig. 10 (b) shows the basic timer with typical additional contacts associated with its

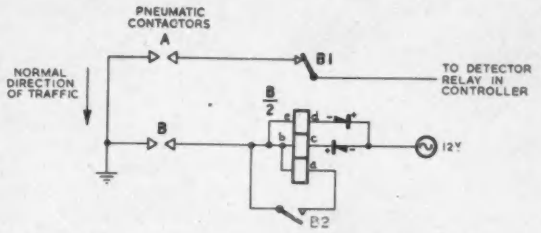


Fig. 6. Single line diagram showing how the uni-directional detector control is achieved

use. With contact K operated alone, the timer is able to pre-time an interval but cannot trigger due to ST. With contacts K and ST operated however the timer will trigger at the end of the timed period. Assuming a period is being timed, contact AR provides a reset feature by effectively shunting C and thereby restarting the timed period from zero. This latter facility is utilised, for example, to provide vehicle extensions as described earlier, the AR relay being operated by the revelant detector. Contact S provides a similar shunting feature, but is a mechanical contact associated with the camshaft mechanism and serves to neutralise any unwanted charge in C when the camshaft steps to start a new interval.

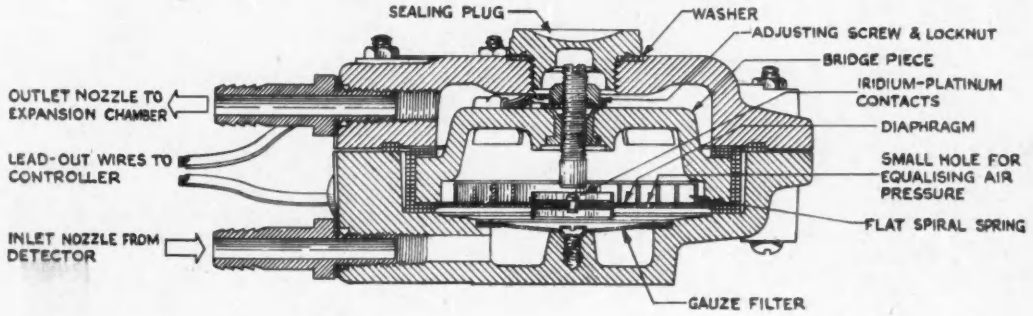
The form of control to be applied to any particular junction can be decided only after careful site observations and close analysis of a traffic census. The general practice is to keep the number of movements or phases down to an absolute minimum compatible with a high safety factor. This ensures the shortest cycle time and the optimum despatch of traffic. In practice it is found possible to cater for the majority of intersections with either 2, 3, or 4-phase control. There are exceptions and reference will be made to these later.

Clearance Periods

The period during which right-of-way is transferred from one phase to another is termed the "clearance period" and in its simplest form as applied to the system so far described, comprises concurrent display of amber to the halting phase and red/amber to the phase about to start. The duration of this period is standardised in Great Britain at three seconds.

However, at many junctions, particularly where awkward turns or wide carriageways are involved, three seconds is insufficient time in which to stop one movement, clear the junction, and to allow a new movement to start up with safety. It is therefore necessary to prolong the clearance time and one method of achieving this is the provision of "sequent ambers" in which case the amber and red/amber are separated and follow consecutively, each being shown for the standard three seconds; a total clear-

Fig. 5. Life size cross-sectional view of the pneumatically operated contactor



ance time of six seconds. Situations requiring yet longer periods are met by the insertion of an "all red" period between the ambers. If necessary, the "all red" can be made extendible by suitably located intermediate detectors, and also automatically suppressed if not required.

Clearance periods of this type ensure maximum safety during the change from one phase to another, as the closing phase definitely receives a red signal at least 3 seconds before green is shown to the opening phase. They can also be made conditional in their appearance in that they appear only between certain changes e.g. leaving phase A when going to phase C, leaving C when going to B etc. to meet individual requirements.

Use of Clearing Periods

Whilst apparently somewhat involved, such clearance periods are extensively used, particularly at "sprawling" junctions and narrow roadways or bridges. A typical installation of this type is illustrated in Fig. 1. The site is Corbridge Bridge, Northumberland, the bridge being some 160 yds long and spanning the River Tyne. Whilst the approaches are wide enough to permit two lanes of traffic the bridge itself is wide enough for one lane only. It is totally unsuited for any form of manual control and is an ideal example of road signal application.

Each approach to the bridge is detected in the normal manner and, subject to vehicle demands, the right-of-way is allocated to each route alternatively, the duration of the green periods being as already described for the simple intersection. Dependent on traffic flow, the changeover or clearance period required may vary from a minimum of three seconds as in the case of a demand arising some time after the last vehicle has crossed the bridge, or extend to a full clearance time of the order of 20 seconds if a vehicle enters the bridge immediately prior to a change and crosses at approximately 15 m.p.h. With the aid of additional "all red" extending detectors spaced at intervals of approximately 50 ft along the bridge, the controller accurately plots the progress of the vehicle and adjusts the clearance period accordingly in the following manner. Following the termination of a green period, an "all red" clearance period is provided, its duration being sufficient to allow a vehicle travelling at normal speed to cover the distance between any two adjacent "all red" extending detectors. Any vehicle already on the bridge must therefore cross one

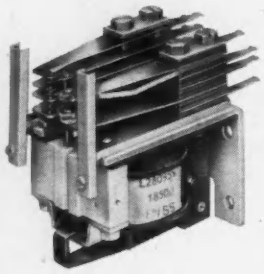


Fig. 7. (left) Controlling unit of a three-phase road traffic control system in its outer case

Fig. 8. (above) Typical a.c. operated relay employed in an "Electro-matic" controller

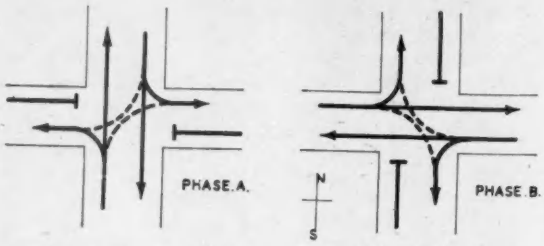


Fig. 9. Two-phase traffic control of a simple road junction

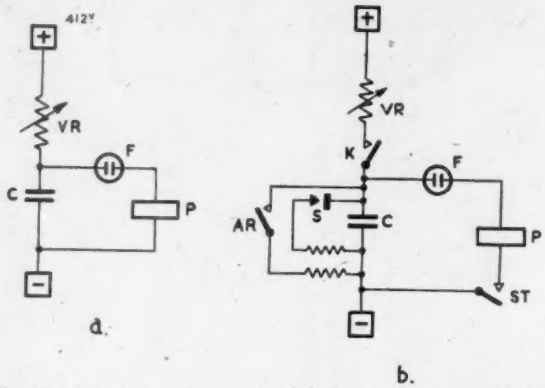


Fig. 10. Basic timing system employed in all control systems, modified in (b) by the addition of contacts associated with the system to be used

of the detectors in its path during this period and in doing so automatically extend the "all red" for a further period in a similar manner to that described earlier for vehicle extensions. Thus the vehicle progresses across the bridge from detector to detector until finally, in the absence of further extensions, the "all red" period is terminated and the changeover to the opposite route is completed.

Under conditions whereby one route is showing green and no opposing demand exists, an additional "All Red Suppressor" timing circuit is introduced. Its predetermined time period commences at the actuation of the approach detector on the running phase, each operation serving to re-start the period from zero. If the gap between the last vehicle extension and the arrival of an opposing demand is greater than the time allowed for a vehicle to safely traverse the bridge, the suppressor operates and the adjustable clearance time is suppressed and replaced by the conventional concurrent ambers. The clearance period therefore provides complete safety but is kept as short as possible commensurate with the conditions prevailing.

Overlapping Phases

At controlled junctions it is common practice to permit right-turning vehicles to filter through a movement from the opposite direction. In certain cases, however, the through traffic is dense and the turning vehicles have extreme difficulty in completing the turn before the through movement ceases due to the expiration of the green period. This condition tends to choke the junction and is also a source of considerable irritation to drivers. The difficulty can be overcome by the addition of an extra phase with special features of introduction and duration.

Fig. 11 (a) illustrates the layout and 3-phase movements of a simple junction incorporating this special provision for right-turning vehicles approaching from the west. It will be seen that vehicles approaching from the west are allowed to proceed during phases A and B but those from the east proceed only during phase B. As the phases appear in

cyclic order A-B-C, the right-turning vehicles from the west approach are given a separate period in which to move without hindrance, prior to the opening of the main movement during phase B. Such an arrangement is termed an "AB overlap with late start" the late start being with reference to the main movement. The phase A portion of the overlap is usually of fixed duration and is only introduced when required, e.g., when a vehicle or vehicles have been detected in the west approach during the phase C movement. In the absence of such detection right-of-way can be transferred directly from phase C to phase B. This form of overlap is most advantageous when the relevant approach is narrow and there is insufficient storage space for turning vehicles to wait without impeding other traffic.

An alternative form of overlap shown in Fig. 11 (b) is utilised where the relevant approach is wide enough to permit the turning vehicles to wait without impeding the through movement from the same approach. It is, in fact, the reverse of the above, the turning movement being arranged to follow the major movement and is termed an "AB overlap with early cut-off." To cater for "tidal" traffic,

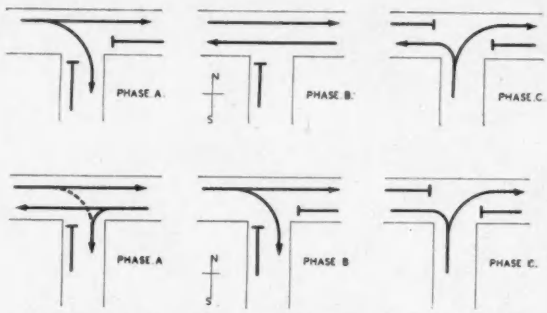


Fig. 11 Three-phase traffic control system at a road junction incorporating an overlapping phase (a) (above) with late start AB overlap and (b) early cut off AB overlap

either form of overlap can be made to appear only during certain hours by means of a time switch housed in the controller.

Filtration

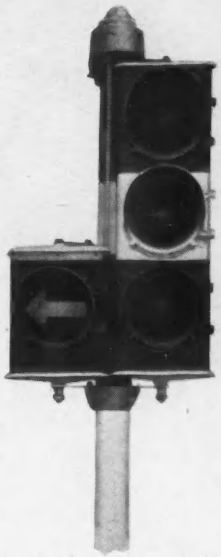
Conforming to the general policy of signal control, namely, to maintain maximum movement allied to safety, it is sometimes possible to permit a left-hand turning movement on a route which is otherwise held in favour of an opposing phase. In such a case indication is provided by means of a green arrow signal as illustrated in Fig. 12 together with the standard 3-aspect signal. This gives precise indication that only left-turn traffic can proceed in safety. The actual direction of the arrow can be adjusted to match the angle of the two roads involved.

The introduction of the filtration signal is made dependent on the operation of the detector in the approach it serves, and also on the appearance of the phase during which filtration may occur. The phasing is also so arranged that once the green arrow appears it is always replaced by a normal full green signal.

The Pedestrian

In the early years of signal control, the pedestrian was largely ignored, control being primarily concerned with vehicles. Indirect indication was sometimes provided by the addition of extra signal heads which repeated the vehicle signals and made it easier for the pedestrian to see

Fig. 12. Three-aspect signal with a green arrow permitting a left-hand-turning filtration



which route had right-of-way, so enabling him to "walk" with the traffic." The system, however, afforded him no protection from turning vehicles. Experience has shown that quite apart from the fact that uncontrolled pedestrian traffic at a junction can seriously interfere with vehicle traffic movements , there exists a potential danger of serious accidents, particularly to pedestrians. Consequently, the modern tendency is to regard pedestrians as traffic units as in the case of vehicles, and where such traffic is heavy, to make special provision for it.

Well-defined pedestrian lanes are located on the junction side of the vehicle stop lines and "Cross Now" signals are provided facing inwards over the lanes. Pole-mounted pedestrian push-buttons are located at the kerb edge. Having once pushed the button the pedestrian merely waits for the "Cross Now" signal, when he can then cross in perfect safety, all traffic being prevented from entering the junction by red signals to all approaches. The "Cross Now" period is usually preceded by an "all red" period to traffic to enable all vehicles already in the junction to clear before the pedestrians walk, and a similar period follows the "Cross Now" to enable pedestrians to complete their crossing before any vehicles are released.

(To be concluded)

YELLOW OR WHITE?

AFTER motoring on the Continent some motorists return convinced that the yellow headlights used in France are far less dazzling than the white lights used in Britain. In order to find out if there are any advantages in using yellow light some new experiments have been carried out at the Road Research Laboratory.

A test track approximately half a mile long was built. Man-sized rectangles of sacking on wooden frames were set up in two lines, one on either side of the road and small obstacles were placed in the centre of the track.

In the tests two cars set off from opposite ends of the track at the same time, each car carrying two pairs of typical French headlights of the latest design. One pair of lamps on each car was fitted with yellow bulbs as normally used in France, the other pair with clear bulbs. The two pairs of dipped lights on each car were similarly aimed and were adjusted to give the same light output.

Rather more than half the 20 drivers tested preferred white light when meeting cars similarly equipped to their own and nine out of ten preferred white lights when driving on a clear road. However, six out of ten drivers thought yellow light slightly less glaring, but all felt that all differences between the systems were small. It was found in another sets of tests that there was no significant difference in the distances drivers could see with yellow or white light. It can, therefore, be stated with confidence that changing over to yellow light will not solve the dazzle problem.

The Industry Surveyed

I.E.E. Local Centre Chairmen range widely in delivering their Inaugural Addresses

CHAIRMEN of Local Centres and Sub-Centres of the I.E.E. deliver their inaugural addresses over a period of some weeks. For convenience, it has become our practice to summarise these addresses in one or two issues of the ELECTRICAL TIMES, and this present article is the first of those covering the session 1954-55.

A start may be made with the address entitled "Is there a foreseeable limit to the demand for electricity," delivered to the Southern Centre by MR E. A. LOGAN. The declared object of this address is the estimation of a plausible upper limit to the consumption of electricity in this country. Since the inception of a public supply, the output of electricity (units sold) has doubled approximately every ten years, despite limits that informed opinion has set from time to time. As a result, a feeling has been induced, that there is no upper limit to the consumption of electricity. In Mr Logan's view, however, there is a limit, though it is well in excess of present day requirements.

Two lines of estimation lead to approximately the same conclusion: the consumption of electricity will continue to increase rapidly until a population of 55m people will consume some 260,000m units of electricity yearly (about four times the present level). Thereafter, the rate of increase is likely to be greatly reduced, and to move in step with population. The possibility of an unlimited expansion of electricity is rejected because it is felt that a consumer will only use electricity to satisfy his reasonable requirements. Much of the expanded use of electricity up to the present date has been a result of substituting that form of energy for coal, gas and other fuels. It is felt that a great extnsion of the average consumer's need for fuel and power cannot be envisaged.

Mr Logan's address concludes with a warning that the forecast ceiling is only an order of magnitude, which depends on maintenance of the present gradual improvement in the price of electricity in relation to competitive forms of fuel and power. Any dramatic relative cheapening of electricity would both accelerate electricity development and raise the ceiling.

Cable Developments

To the uninitiated user, one piece of cable is much like any other. This remark was introductory to a complete survey of the materials, technique and developments in cable manufacture today, as delivered by the Chairman MR P. R. DUNN in his address to the Mersey and North Wales Centre. The growing use of reinforcements for pressurised cables and aluminium sheaths has focused attention on improved methods of protection against electrolysis, organic acids and alkalis. A significant development in this sphere has been the replacement of bitumen impregnated textile servings by tapes of self-sealing rubber and p.v.c.

It is of interest to examine some of the developments in cable design and construction resulting from the availability of new materials and from the advances in performance achieved to meet modern requirements. This point was illustrated in the section on lighting and power cables where there has been an increased use of rubber insulated and sheathed cables for wiring and experience coupled with advances in manufacturing technique and rubber technology has allowed overall reductions in diameters of many cable types to be made. The use of p.v.c. is growing and on the continent cables suitable for burial in plaster have been produced. These have widely separated p.v.c. insulated cores enclosed in a rubber sheath which provides a web through which fixing nails and screws are driven.

In the aircraft field, lacquered cotton braided vulcanised rubber used pre-war operated at a temperature ranging from $-10°$ to $+70°$ C; these were replaced by plastic insulated cables. Present-day cables used in jet aircraft, however, have silicone rubber insulation covered with glass fibre braid and operate at higher temperatures, but unfortunately their resistance to paraffin is low. The introduction of ester-based lubricants in aircraft has also led to the use of extruded nylon sheaths. Where even higher temperatures have to be catered for, cable insulated with polytetrafluoroethylene and glass-fibre braid can be operated on a range of $-75°$ to $+250°$ C. Their use is limited by high cost and scarcity of material. For special uses in hot zones, a cable with glass fibre impregnated with silicone varnish is used. This is suitable for temperatures up to 400° C but the electrical characteristics limit the application to 28 V circuits.

In view of rapidity with which manufacturers adopt new techniques and make use of new materials, the ever-changing scene makes correct choice of cable for a particular application a difficult task indeed.

Management and Men

MR W. J. CROCKER, in his address to the North Midland Centre, speaks on the topic of "Management and Men," dealing with particular reference to electricity supply practice. He gives special attention to staff selection, pointing out that the salary of each man, if capitalised, represents a considerable sum. The immediate superior should have a predominant share in the short-listing and interviewing of candidates, and he should be encouraged to state his choice, for it is he who will be most closely responsible. On the other hand, on making the final choice, some degree of moral support and guidance is often necessary to hold the balance between fitness for the immediate job in hand, and more general qualities which will fit for future promotion.

In filling staff appointments, the relative merits of promotion of local staff and the bringing in of new blood have to be weighed. In spite of the large area covered by each Board, standardisation of procedures within area boards means that promotion within a board may fail to be satisfactory from the "new blood" viewpoint. In Mr Crocker's opinion, the great majority of appointments should be advertised nationally in order to preserve the spirit of adventure.

Care for education and training is an important function of management, and there is stress here on the need to give really practical experience. In the supply industry the young engineer should be sent out to the district where

the actual work of distribution is carried out, and not allowed to start in some planning job in an office: this apparently obvious rule is still too often neglected.

Steelworks Electricity

Trends in steelworks electrical equipment provide a theme for the address given by MR F. L. PARKIN to the Sheffield sub-centre. He suggests that a steelworks engaged in the manufacture of heavy cast ingots and in rolling them subsequently has a load of 15 to 30 MW. The works with which he is associated (a branch of the United Steel Companies) used 98·7m units in 1953. 72% of this was used in a.c. power and lighting applications, while most of the remainder (27½%) was converted to d.c. for cranes and general works use. Conversion entailed a loss of 10%; 2·7m kWh of energy unproductive every year. This loss means that close attention is given to such alternatives as the mechanical rectifier or direct works generation of d.c.

Power factor correction is a prominent topic at present, as a result of the introduction of two-part tariffs for the purchase of bulk power. There is little opportunity of offsetting maximum demand charges by improving load factor, as mills work 16 shifts per week. On the p.f. question much can be done. Static capacitors are being connected across the terminals of all motors up to 100 h.p. or more and further capacitors are being connected to substation l.t. busbars, with automatic contactor control. For heavy mill motors, operating at 6·6 kV, a synchronous condenser offers some advantage. On this account, Mr Parkin forecasts an increasing demand for synchronous motor drives. He feels that the fly-wheels of Ward-Leonard-Ilgner sets may be dispensed with now that load fluctuations are of less importance in view of the increasing capacity of feeders and transformers. He foresees the appearance of large primary reversing mills with straight Ward-Leonard control.

Amongst other aspects of steelworks practice discussed is the introduction of electronic controls. In particular, the lead-sulphide cell has great possibilities for control operation with hot material. These cells are sensitive to the radiant heat emitted from hot steel.

Students in the Laboratory

Engineering students spend approximately one-quarter to one-third of their total attendance time in the engineering laboratories and are expected over a three-year course to prepare some 100 reports during the first two years and a limited number of comprehensive reports in the third. It was the importance of spending this time usefully under the guidance and experienced lecturer that PROF E. BRADSHAW, chairman of the North Western Centre, stressed in his address entitled "Laboratory Work in Engineering Courses." Too often, that chore the junior laboratory, is delegated to a junior lecturer, who has not the experience nor possibly the responsibility for assessing students. Practical laboratory work is of great value and it is with the new student that this interest has to be developed, and which leads to improved techniques and an understanding of experimental method. During the first year, students' theoretical training lags behind the practical and opportunity is given to demonstrate use of instruments using basic d.c. theory only. As the course becomes more advanced, advantage should be taken to introduce new apparatus. Electronic devices, a.c. bridges and potentiometers should be available. In the preparation of his report, the student needs particular guidance so that the full significance of results obtained is brought home. It is in this sphere that the senior lecturer can prove invaluble.

Irish Communications

MAJOR P. L. BARKER, chairman of the Northern Ireland Centre, is a G.P.O. engineer, and his address appropriately deals with recent telecommunication developments in Northern Ireland. The first topic discussed is the Belfast-Dublin co-axial cable which was brought into full use last month. The cable consists of two tubes of 0·375 in. inside diameter, with a central solid copper conductor 0·104 in. located by slotted polythene discs at 1·3 in. intervals. The outer tubular conductor is a copper strip or tape with crimped edges for interlocking when formed into a tube. Each tube is reinforced with two steel tapes laid together to form a cylinder, and the whole unit wrapped with paper tape. The cable carries 600 speech channels.

In the address, attention is also given to the Belfast television service, which has for some time been operated by picking-up the B.B.C. transmission from Kirk o'Shotts at a receiver on top of the 1,200 ft high Black Mountain. The local transmitting station is only a mile away, but the co-axial cable connecting the two points has a hazardous route. Gradients greater than 1 in 2 have to be dealt with, and in one place a ravine is crossed, the cable being suspended from stranded steel wires.

W. Australia Shows a Surplus

A SURPLUS of £120,791 is shown in the Annual Report for the year ended 30th June, 1954, of the State Electricity Commission of Western Australia. This includes a contribution from the Treasury of £72,000 toward the loss of £80,413 incurred on the South-West Power Scheme. The surplus has been applied to the reduction of the accumulated deficiency incurred by the Commission since it ceased, on 1st July, 1949, to be assisted by contributions from the Treasury to meet the losses involved in the initial years of the Commission's operation. The outstanding amount of the accumulated deficiency account after applying the profits for 1953-54 was £94,512, which it is hoped to liquidate from future profits.

Total capital of the Commission is about £20m and the profit represents only 0·6% of this amount. It is thus obvjous that the Commission operates on a slender margin.

During the year, the Commission raised two public loans and these met with a splendid public response, No. 3 for £1m was oversubscribed five days before closing date, and No. 4 for £935,000 closed fully subscribed five days after the opening date.

The Metropolitan power stations, East Perth and South Freemantle, had a total capacity of 124 MW of which 49 MW was 40 c/s plant and 75 MW was 50 c/s plant. This compares with 103 MW for the previous year, of which only 50 MW was 50 c/s plant. Country power stations had a total installed capacity of 14·7 MW of which 2·2 MW was diesel.

Operationally, the year's working was satisfactory although the old and uneconomical East Perth "A" station had to be used because of the demand at the winter peaks. Coal used (lb/kWh) rose from 1·71 lb in 1952/3 to 1·75 lb in 1953/4. Major reconstruction is taking place at the Perth "A" station, and the year saw the commissioning of the first plant at the South Freemantle "B" station.

In the South-West Power Scheme, the rapid extension of transmission lines in all areas enabled the closing down of remaining diesel stations with the exception of Albany. The elimination of the smaller diesel stations will result in more economical working. By the end of the year the survey of the first 132 kV transmission line from Bunbury to Cannington was completed and the clearing of the line was well advanced. Work also began on the Wellington Dam hydro-electric plant.

Accidents at Home

1953 DOMESTIC ELECTRICAL FATALITIES ANALYSED

THIRTY-FIVE electrical fatalities which occurred in private houses during 1953 are the subject of a précis issued by H.M. Senior Electrical Inspector of Factories in his capacity as Electrical Adviser to the Home Office. This does not necessarily imply that this is the total of accidents that occurred.

Most of the usual causes of such accidents are present in the list: causes which have been the subject of propaganda for many years. Amateur wiring was directly involved in the chain of events leading to six of the accidents: the absence of earthing in five, while in four cases the connection of a single-pole switch in the neutral conductor of an a.c. supply played a part. There were four fatal accidents in which worn flex or cable insulation was important. Last year, however, at least one foolish indulgence claimed less victims: only two victims died due to using an electric fire in a bathroom. The accompanying table analyses the accidents by reference to the apparatus or appliances involved.

TYPES OF APPARATUS AND APPLIANCES INVOLVED IN FATAL ELECTRICAL ACCIDENTS IN THE HOME

Faulty wiring (lamps) ...	6	Electric vacuum cleaners	1
Unguarded portable lamps	1	Electric drills	2
Electric fires	4	Electric hairdryers ...	1
Electric irons	9	Power cables	3
Electric kettles	2	Electric washboilers ...	2
Switch sockets	2	Wireless receivers ...	1
Plugs	1		—
		Total	**35**

It is not possible in the space available to summarise all the information presented about the accidents. In any case many of the accidents are relatively straightforward cases of broken mouldings and exposed live contacts. There are several instances, however, where the particular fault or the combination of circumstances presents a less obvious warning.

Intrusive Earth

An accident in which a woman was electrocuted illustrates by the number of "chances" involved, the essential safeness of electrical installations in the home. At the same time, its very occurrence emphasises the need to take all practicable precautions. The woman had come into contact with an electric fire, and this proved to be in a bad state of repair, with one element broken and several screws missing: also missing was the nut that should have held in position the earth core of the three-core flexible lead to the fire. This was twisted round the earth terminal, however. Yet instead of a safety precaution, it introduced danger. At its remote end, in a three-pin plug, the earth core had become detached from the earth pin and welded itself to the live pin.

Although this undesired connection made the frame alive at about 250 V to earth, there was still no serious danger in an earth-free room, and at first sight the wooden-floored room in which the fire was used appeared to have this characteristic. However, there was an open coal fire in the room, fitted with a back boiler and so effectively earthed. It appeared that the woman had been poking the open fire, and that while doing this her leg had come into contact with the frame of the electric fire.

In another case with some similar characteristics earthed metal was more obviously present. The three-core cable feeding an electric iron was terminated in a two-pin plug, and within the plug, the earth core had come into contact with the live pin. It appeared that the woman received the shock when touching simultaneously the casing of the iron and a gas cooker. As she fell, the heat of the iron burned the wooden floor of the room, thus starting a fire by which her body was largely consumed.

A further accident in this category involved a woman who tried to repair a kettle connector while the other end of its associated lead was still plugged in to a three-pin socket-outlet. She attempted to replace a nut that had fallen from a contact-tube, and received a shock from her right hand holding the nut to her left hand, which grasped the kettle connector. Her left hand was in contact with the connector's earth continuity clips, which were earthed via the third pin of the associated plug. Apart from these clips, the surroundings were earth-free. Had the socket outlet been left unearthed, in this particular earth-free situation, then the accident would not have happened.

Another accident in which a housewife was the victim echoes a point emphasised in a recent Factory Inspectorate report about the danger of small items of unearthed metal on otherwise protected portable tools. A hair dryer was the cause of the accident. It had a wire spiral spring to protect the associated cable, and this had become live in some way. The metal casing of the hair dryer was well earthed, and it was contact between this and the live spring with both hands involved that led to the fatality.

Below Mains Voltage

In an accident in which a youth of seventeen was killed there is a warning that it is not only mains voltages that are dangerous. A cinema projectionist, he was in the habit of tinkering with the family wireless set when he returned home late at night. Early one morning he was found dead, sitting in an armchair clutching in one hand the bare end of a length of flex which he had apparently intended using to connect a gramophone pick-up. The youth had obtained a shock across two leads at 80 V d.c., and the leads had also carried an a.c. leakage at 60 V.

The six accidents involving portable lamps are largely a warning against amateur electricians, but two of them have further lessons. In one case, a light was rigged up consisting of a screw cap lampholder mounted on a length of conduit to act as a stand. The lampholder was supplied from a three-pin plug by a three-core t.r.s. flexible cable. Black and red leads were crossed in the plug, however, with the result that the live core was connected to the outside of the lampholder. Further, the earth core was not connected to the stand. This, becoming live, electrocuted the user.

In the other case the lamp was more conventional, but it lacked a wire guard for the protection of the bulb. The user apparently slipped while standing in a pool of water repairing a car, and knocked the lamp against the car. The glass was smashed, and the car made alive as a result of the filament touching the radiator. When found the man was lying dead, with his chin resting on the carburetter.

notes on wiring

by Megohm

ELECTRICAL installations are probably more varied in character and extent in modern hospitals than any other building or group of buildings of similar size. The vast amount of electrical apparatus used by hospitals today calls for careful consideration on the part of the person responsible for the layout. It is rather difficult to plan an installation to suit the individual tastes of the people in charge and keep in mind the fact that their successors may have completely different ideas. This, of course, refers mainly to lighting, positioning of sockets etc. The matter of the services to the departments and outlying blocks can be dealt with in the normal way, but I have found the arrangements *inside* the departments quite another matter.

Distribution

The distribution system for the electrical services to the various buildings is usually determined by the geography of the site. The architect has usually given due consideration to all services, and ducts to house the hot water and steam services can be arranged to take the outgoing cables. Preliminary consultation between the architect and those responsible for the various services is most essential in such cases. It must be ascertained that the cables will not foul the other services, and vice versa, and the question of the duct temperature must be gone into.

The usual method of distribution for lighting and power is by the ring main method. Each end of the ring main cable should be connected to a separate iron-clad switch or circuit-breaker on the panel in the switchroom. At a suitable position in each of the outbuildings, the ring main is looped into switchgear which, in turn, serves the fuseboards. The size of the cable is, of course, determined by the permissible voltage drop and should be of equal copper section throughout its entire length. At the "loop-in" positions it is good practice to install solid copper links in order that the sections of the ring main cable can be isolated, should a fault occur, by removing the links at either end of the faulty section. The supply can still be maintained to all buildings whilst the necessary repairs are carried out. It is, therefore, most important to make certain that the cable is of sufficient size to take the whole of the load in the event of a fault developing on a section close to the main board. I realise that it is not always practicable to take the "ring" into all buildings and where this happens, a cable should be run from the nearest "loop-in" position. As this cable will probably be of smaller cross section than the ring, cut-outs should be installed to provide a safeguard for the cable and also for isolation purposes if required. I would emphasise the need for clearly labelling all "loop-in" positions, cutouts, etc.

One of the major problems in hospital work is the question of balancing the load. It is often the case that when the buildings are put into commission the "paper" balance is far from satisfactory. I have already met this problem and find that the best solution is to provide "selection" links in the switchgear so that the load on each phase can be adjusted. This is a matter which requires great consideration at the start of the planning period. It must be realised that at certain times of the day heavy loads are connected. For instance, food trolleys, which are becoming an essential piece of apparatus in hospitals, have usually a 2 kW element and it is quite usual for a small hospital to have ten such trolleys.

Other Services

Telephone, fire alarms, impulse clocks, radio and staff location systems also play an important part in the modern hospital. These services require multi-core cables, and I find that the telephone is so much used to-day that it is better to keep the cable for that service only and not to combine it with others. The radio system cables should not, in my opinion, be combined with those for the telephones because of the possibility of inductive interference.

I make a point of providing a test in each building and also at lift shaft positions, for, in my experience, hospital personnel require telephones in the most out of the way places. The type of test box, too, requires consideration and I prefer the type which has the connecting strip anchored to a screw so that by loosening the screw the connection is completely broken. This greatly assists when tests are being carried out. The matter of marking up the various lines must be dealt with and, in the case of telephone systems, the markings should be such that alterations can be easily noted, otherwise the inside of the lid in time bears a mass of scribbled notes which are most misleading.

It is essential to provide a separate cable of ample size *direct* from the intake room to the X-ray apparatus room. No other circuits should be connected to this cable along its route, at it is most essential that no voltage fluctuation takes place during the exposure period. A 3-phase supply is most desirable for X-ray apparatus as the majority of the equipment is designed for operation on 400/415 V, connected across two phases. A single-phase supply is also desirable as many of the couches are tilted by means of a small motor.

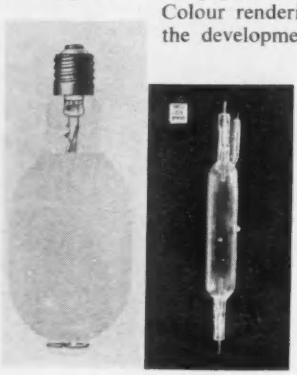
Every X-ray department has its own dark room for developing the films and special lighting is required. Ventilation must be provided and fans must be fitted with light-proof attachments. Whilst films are being developed, "safelights" are used and the main light is switched off. I recently met someone in charge of developing films and he showed me how he overcame the difficulty of switching the main light on in the dark. He had fixed a ceiling pull switch on the *wall* and taken the cord across the room to a hook on the opposite wall. It is a simple matter to walk across the room from any position with one's arm stretched upwards and find the cord. Film hoppers are normally fitted with a door type switch, which cuts out the main light when opened, to avoid damage to the films.

I have, of course, failed to cover the most common thing of all—lighting and power requirements. This is entirely due to lack of space and I hope to return to this subject in the near future.

New Colour Corrected M/V Lamp

ANNOUNCED last Monday by members of E.L.M.A. is a new high-pressure mercury vapour lamp which provides a marked improvement in colour-rendering properties. This lamp, which has an Edison screw fitting, has a consumption of 400 watts, and has been developed from the 80 and 125 watt lamps which were introduced in September of last year. Thus the advantages of colour correction are now available in a size of lamp widely used for lighting large interiors and for outdoor illumination. The lamp has a high efficiency and may be used with the same type of auxiliary gear as the 400 watt MA/V lamp.

Colour rendering has been improved by the development of new types of phosphor which are capable of producing a relatively high percentage of red when excited by ultra-violet light. In the Osram version the phosphor used is germanium based, and it is probable that similar types of phosphor are used in other makers' lamps although this has not yet been disclosed.



On the left is a general view of the lamp, with right, the inner quartz assembly

A considerable improvement in efficiency has been achieved, the output being 16,800 lumens (average) throughout life, while the size is somewhat smaller than that of an ordinary 500 watt tungsten lamp.

An important characteristic is that the lamp may be burned in any position without requiring a magnetic deflector. This has been attained by making the space within the quartz tube, which contains the discharge, sufficiently restricted to prevent bowing upward of the arc —a phenomenon which occurs when the more conventional mercury vapour lamp is burned horizontally. The refractory characteristics of quartz permit the high wattage loading per centimetre of arc which is necessary for deriving maximum luminous efficiency from an arc of limited length.

The new lamp is likely to find a wide field of application for industrial interior lighting and will permit an increase in luminous efficiency compared with installations at present using a combination of mercury and tungsten lamps in order to provide an acceptable colour. Space floodlighting outdoors is another sphere for the lamp, particularly in areas such as garage forecourts and car parks. In street lighting the lamp may commend itself in some cases as an alternative to fluorescent lanterns.

The price of the MBF/U 400 watt lamp is £9 and it is not subject to purchase tax.

Selling Motors to the States

IN 1953, the United Kingdom was the principal foreign supplier of electric motors to the U.S.A. The value of the machines concerned was $838,532, having risen from $437,839 in 1951. Factors involved in extending this trade are the subject of a market digest recently prepared by the Commercial Department of the British Embassy in Washington. Motors imported into the U.S.A. are subject to a 12½% ad valorem duty unless they are an integral part of some appliance, or designed as such: in this latter case they attract the same duty as the appliance concerned. It is recommended that all motors should conform with N.E.M.A. standards, and so great is the preference for such motors amongst customers that it is considered that such compliance should be stressed in sales literature. In certain cases where the motors are to be used for home workshop tools, the approval of Underwriters Laboratories Inc. may be advisable.

Internal U.S. production of electric motors was about 45 million in 1953, of which some 9 million were in the f.h.p. range. Demand has been increasing, particularly for the high powered range of f.h.p. motors. A recent survey has shown that a modern American farm uses as many as 28 different kinds of electric motor!

Entering the Market

From a business point of view, effective entry into the market will be made only by underselling U.S. manufacturers. Most of these manufacturers are represented by commission agents having an exclusive territory or by their own sales staff: the rate of commission appears to be about 10% basic. Representatives usually have considerable technical knowledge. Leading supplies such as General Electric and Westinghouse have a sales staff specificially concerned with development of sales to original equipment manufacturers, and they also have their own wholesale supply house.

It is worth noting that some 120,000 retail stores are now selling small motors. At retail level, in sales to farms and homes, the leading mail order houses have a dominant position, especially for f.h.p. motors. In some cases, these sell motors up to 5 h.p. in their own name.

Apart from discounts to representatives, industrial users may be given 15% off list price, municipalities some other agreed percentage, and retail outlets from 10% to 40%. The discount structure varies between firm and firm. Just how much price advantage an imported motor needs is difficult to assess. Many customers associate high price with superior quality, and there is a danger that too great an offer of price advantage may be regarded suspiciously. Maximum emphasis on quality and service may well be considered more important in securing sales than emphasis on price advantage. In general, however, U.K. firms have a definite cost advantage over U.S. manufacturers for integral h.p. motors.

There is a feeling that possibilities for imported f.h.p. motors are poor. On integral h.p. machines there is a greater variety of opinion, but it does appear likely that any new entrant to the U.S. market would find it necessary to offer a complete range of motor sizes and styles, though a limited sales operation based on a particular type of motor has in the past proved feasible.

Service and spares should be equivalent to those offered by U.S. manufacturers. There seems to be no apparent reason why local motor repair shops should experience any difficulty in repairing of British motors conforming to N.E.M.A. standards.

Neutral Earthing

in Power Transmission Systems

ANALYSIS OF THE FACTORS DICTATING THE OPTIMUM METHOD

By **A. SALZMANN**, DIPL. ING., A.M.I.E.E.

IN the early days of power transmission, networks generally operated with an insulated neutral. The advantage gained was that the supply system continued to operate normally in event of a line-to-earth fault, because the fault current involved was insufficient to operate the protective gear, and arcing earth faults due to the small capacitance current were self-clearing.

However as systems grew larger, and higher operating voltages were applied, this practice became obsolete, as it was found that arcing earth faults, due to large capacitance currents, produced dangerous overvoltages on the sound phases resulting in breakdown. Thus cross-country faults on dissimilar phases and at different locations were cleared by overcurrent protection, and cut off larger sections of networks than should be required by single line-to-earth faults. The advantage of networks with un-earthed neutral consequently disappeared as the system grew larger.

Today earthing of the neutral is an established practice, and its object is (*a*) Elimination of earth fault current or its reduction to a small value—without jeopardising the operation of the protective gear—and (*b*) Restriction of dynamic and transient overvoltages on the healthy phases caused by fault current (or switching operations) within the insulating strength of the connected equipment.

Thus the problem which arises is not "should the system neutral be earthed" but "which is the best method of earthing?" Here we have solidly, partially solidly, resistance, reactance or resonant neutral earthing. The solution is not so easily attained and the choice of earthing method is still a controversial problem in many countries depending on the network characteristic and service voltage.

In this country, solid neutral earthing is standard practice for transmission lines operating at voltages in excess of 66 kV. For systems operating at 33 kV or less, resistance and solid earthing are predominant. Untuned reactance earthing is not popular in Great Britain, and the same applies to resonant phase earthing (Bauch Transformer) but resonant neutral earthing using the arc suppression coil (A.S.C.)[1] is becoming increasingly popular, particularly for systems operating at or below 33 kV.

In most cases, however, the A.S.C. is paralleled automatically with a low value earth resistance if a fault persists for several seconds. Thus resonant neutral earthing is converted into resistance earthing for persistent faults and the advantage of A.S.C. earthing, which is to leave the faulty section in service for a short period is sacrificed. In fact, in this country, the task of the Petersen coil is primarily to deal with single line-to-earth transient faults.

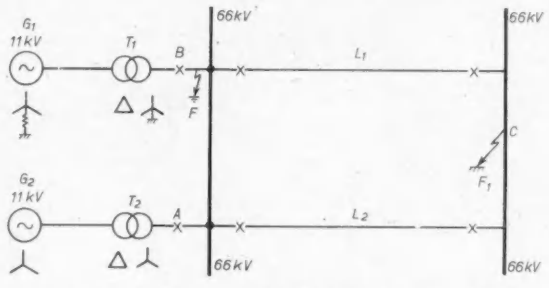


Fig. 1. One line diagram of a typical three-phase power system

The U.S.A. prefers more or less the same earthing methods as Great Britain but in addition untuned reactance and partially solidly neutral earthing is in use. In Germany, however, and most of the countries in Europe, resonant neutral earthing is predominant. There is a tendency in some countries to apply this earthing method only to transmission systems operating with voltages below 110 kV. In France, for example, untuned reactance earthing is adopted for overhead line systems and resistance earthing for cable networks, while the Soviet Union favours either partially solid earthing or un-earthed neutral or reactance earthing.

Fundamental Considerations

Neutral earthing is not only a technical problem it is also an economic problem.[2] In the case of solid earthing, no resistance is intentionally inserted between the neutral point of the system and earth. The earth fault current in the event of a line-to-earth fault is thus restricted only by the line reactance and fault path resistance and is likely to exceed the system 3-phase fault current. In this case a circuit-breaker of higher rupturing capacity than for a 3-phase fault will be required which, of course, involves a higher cost. This applies particularly to supply points near a generating station when several transformers are operating in parallel. (See Fig. 1 assuming T_1 and T_2 are solidly earthed.) Proof of this statement will follow.

However, if the star points of some transformers are solidly earthed and the remainder operated with insulated neutrals, the line-to-earth fault current and consequently the short-circuit rating of the circuit-breaker can be reduced considerably. This method of earthing is known as "Partially Solid Earthing." (See Fig. 1. Fault location "F" and assume only T_1 is solidly earthed.)

As regards system overvoltages, a solid single line-to-earth fault in a system with solidly earthed neutral may cause the dynamic overvoltage between healthy lines and earth to rise to a value exceeding the phase voltage, because the voltage drop produced by the current flowing through the earth connection is added to the line-to-earth voltage of the unfaulted phases. In addition the heavy fault current flowing through the loop (faulty phase-earth fault path) which is coupled inductively to the healthy phases produces an additional voltage between unfaulted lines and earth, and in the case when the latter is additive, the 50 c/s overvoltage of the healthy phases becomes larger.

Generally the main advantages of solid neutral earthing are that (*a*) The use of power transformers with graded insulation is permitted particularly in the range 110 kV to 400 kV. (The insulation is graded down from the line

terminals to the neutral point which, of course, results in a reduction in transformer costs) and (*b*) Reliable operation of the protective gear is assured.

The disadvantages are first, possible damage at the point of the fault to the equipment consequent on the large fault current, and second, the need to use circuit-breakers of higher rupturing capacity near the source of supply than those required for 3-phase faults.

Considering now resistance or reactance earthing. The resistor or reactor is placed intentionally in the connection between the neutral point and earth with the object of limiting the fault current thus decreasing the great stresses and damage at the point of fault. However, the voltage drop produced by the current flowing through the earthing resistance or reactance is added to the line-to-earth voltage of the unfaulted phases and consequently increases the neutral phase shift voltage, and, of course, the dynamic overvoltages, between healthy phases and earth. It is obvious that the increase in voltage will depend on the magnitude of the impedance between the neutral and earth.

With this method of earthing the rupturing capacity of the circuit-breaker is lower than required for solidly neutral earthing, but the system insulation level is higher compared with solid, or partially solid neutral earthing.

Summarising, therefore, the factors influencing the selection of neutral earthing schemes are:

(*a*) Earth fault current: The reduction of earth fault current should eliminate damage to equipment at the point of fault but should be sufficiently large to secure satisfactory operation of protective gear.

(*b*) Directional earth fault relays: Residual voltages at any location should be ample for relay operation.

(*c*) Insulation level: Overvoltages between unfaulted phases and earth should be maintained within the insulation strength of the connected equipment.

Transient Overvoltages

The second type of overvoltage generated internally by switching operations or caused by fault current is also a function of the method of neutral earthing. Generally transient voltages produced by switching and persisting for times up to few thousand micro-seconds can be controlled by the circuit-breaker and system design. In the elementary single-phase circuit shown in Fig. 2, which illustrates the clearing of a solid fault by opening circuit-breaker CB, when the contacts carrying a heavy current open (we assume that CB interrupts the circuit exactly at the instant of "current zero") there will be sufficient potential gradient (volts/in.) to maintain an arc after the instant of current zero. This is due to ionisation which leaves the arc path still conducting. The capacitance (C) determined by the length of the line is no longer shunted by the fault and the voltage across it changes from a small value (arcing voltage) to a large value (restriking voltage) because of the quadrature relationship between current and voltage. This assumes that the resistance of the circuit is small in comparison to the reactance. The restriking voltage at the instant of "current zero" may reach, theoretically, a peak value twice that of normal phase to neutral voltage.

By multiple restrikes, the transient voltage persisting from the first "current zero" up to the final arc extinction can build up to a very high value. Its magnitude will depend on the design of the circuit-breaker and the method of neutral earthing, and will return to normal after a series of oscillations. Generally it can be assumed that the ratio of the highest peak value of the overvoltage to the peak value of the phase-to-neutral will seldom exceed five for an insulated or resonantly earthed system and three for a resistance earthed system.

The natural frequency f_n of the oscillations set up subsequent to clearing of the fault by the circuit-breaker is a function both of the inductance L and capacitance C and varies inversely as the square root of the product $(L \times C)$ $(f_n = 1/(2\pi\sqrt{LC}))$ neglecting the damping effect of the resistance. Since L is mainly determined by the generating capacity, and C by the length of the feeders a system with small capacitance may cause very high natural frequencies and hence a rapid restriking voltage rise because the time between peak values is extremely short. In consequence severe interrupting conditions will be imposed on the breaker. The same applies to a power system with increased generating capacity and constant value of C. A system with large capacitance, say with several feeders in circuit, has a low natural frequency and has, as a result, a slow voltage rise, because the time between peak values is longer.

It should be emphasised that the circuit shown in Fig. 2 has only one single frequency transient because the circuit comprises one mesh. Generally the transients will have different natural frequencies due to multiple mesh-circuits.

Switching Surges

The magnitude of the voltage generated by switching operations is of great importance when fixing the insulation level of a system and consequently dictates the cost of insulation, particularly for underground cables in lower and higher voltage systems. In cable networks and higher voltage overhead line systems, overvoltage produced by switching play an important part in fixing the insulation level of the system because they are fairly immune to overvoltages produced by atmospheric disturbances. In lower voltage overhead line systems, however, atmospherically produced overvoltages are of primary importance, when assessing the insulation level of the system, while switching surge voltages have no great effect.

It is therefore important to reduce the peak value and the rate of rise of the restriking voltage (RRRV volt/micro-second). This is accomplished by proper design of the circuit-breaker such as by *a*) speeding up the contact movement (high-speed fault clearance), (*b*) resistance switching particularly when using air blast circuit breakers and (*c*) using an arc control device (Cross jet; De-ion Grid contact, etc.) to restore the dielectric strength of the arc path at the instant of "current zero" quicker than the rate of rise of the restriking voltage (RRRV/micro-second). A high RRRV has the effect that the arc path has no time to cool and De-ion sufficiently. and consequently may cause the arc to restrike. Thus the arc is likely to restrike if the voltage across the contacts rises faster than the dielectric strength of the arc space recovers.

The magnitude of switching overvoltages depends both on the circuit-breaker design and the constants of the circuit to be interrupted. Thus the factors effecting the severity of the duty with which the circuit-breaker has to cope are not only the fault current but also the rate of rise of the restriking voltage which in turn depends on the method of neutral earthing. Circuit-breakers may become unsuitable for duty at certain locations because they are not able to deal with the increased RRRV or alternatively with the fault current. With the growth of the generating capacity, however, the fault current may remain constant by re-arranging the circuit but the circuit-breaker may still remain unsuitable to deal with RRRV.

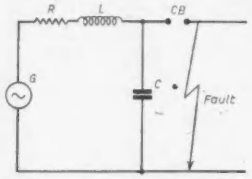


Fig. 2. Circuit interruption: simplified single frequency circuit

Application of Symmetrical Components

The best method in analysing fault currents and dynamic overvoltages in relation to neutral earthing schemes is to use symmetrical components. Considering again the circuit shown in Fig. 1. According to the theory of symmetrical components the earth fault current is equal to

$$I_E=3\ E/(Z_1+Z_2+Z_0+3R_F) \quad \ldots\ldots\ldots\ldots (1)$$

and the 3-phase fault current for a fault clear of earth is

$$I_{3\phi}=E/Z_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where E=generated e.m.f. (phase value expressed in volts or in per-units); Z_1, Z_2, Z_0, are the pos. neg. zero sequence impedances respectively and R_F the fault resistance viewed from the point of fault, expressed in ohms or in per-units.

It is apparent from eq. 1 that an increase in the zero sequence impedance $Z_0=R_0+jX_0$ (say R_0 is increased by inserting resistance between neutral point and earth) will result in a decrease in the fault current. Actually the factor influencing the magnitude of the fault current is the ratio

$$K=\frac{Z_0}{Z_1}=\frac{R_0+jX_0}{R_1+jX_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

This is the ratio of the zero sequence impedance Z_0 to the positive sequence impedance Z_1 (usually R_1 is small as compared with X_1).

Combining equations (1) (2) and (3) and substituting $Z_1=Z_2$, which is justified, we obtain

$$I_E=\frac{Ea}{2+b+K} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$I_E=I_{3\phi}\frac{3}{2+b+K} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where $a=3/Z_1$ and $b=3\ R_F/Z_1$. For a double line to earth fault we obtain

$$I_{E1}=I_{3\phi}\frac{3}{1+2K} \text{ assuming } b=0_1$$

In a similar manner we can derive with the aid of symmetrical components the line-to-earth voltages at the point of fault.

$$V_R=\frac{Vb}{2+b+K} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

$$V_Y=-0{\cdot}866V\ \frac{\sqrt{3}\ (K+c)+j\ (2+b+K)}{2+b+K} \quad \ldots (7)$$

$$V_B=-0{\cdot}866\ V\frac{\sqrt{3}\ (K+c)-j\ (2+b+K)}{2+b+K} \quad \ldots (8)$$

where $c=R_F/Z_1$ and V=line to neutral voltage

Earthed Neutral System

According to B.S.S. 116:1952 an earthed neutral system is one in which the neutral is connected to earth either solidly or through a resistance or a reactance. The system is effectively earthed if the maximum dynamic overvoltage to earth of the unfaulted phases during a line to earth fault does not exceed 80% of the line-to-line voltage, or non-effectively earthed if the maximum voltage to earth of the healthy phases exceeds 80% of the line-to-line voltage.

Generally the requirements are met for effectively earthed systems if the ratio of the zero sequence resistance R_0 to positive sequence reactance X_1 is positive and less than one ($R_0/X_1<1$) and the ratio of the zero sequence reactance to the positive sequence reactance is positive and less than three ($X_0/X_1<3$). In fact effectively earthed systems should be considered as solidly earthed because R_0 must be small. However, by increasing R_0 (Resistance earthing) so that the ratio R_0/X_1 becomes positive and larger than one or by increasing X_0 so that the ratio X_0/X_1 becomes positive and larger than three, the system is non-effectively earthed and should be considered as resistance or reactance earthed.

Effectively earthed systems possess favourable dynamic overvoltage conditions but less favourable overcurrent conditions. From equation (5) it follows that the magnitude of a line-to-earth fault current with fault resistance can be equal, larger or smaller than the 3-phase short-circuit current depending on whether the ratio $Z_0/Z_1=1$; $Z_0/Z_1<1$; $Z_0/Z_1>1$; assuming that the X/R ratios of the positive and zero sequence impedances are close together (equation 3). For $Z_0/Z_1<1$ higher cost of switchgear may be involved, because the earth fault current is larger than the 3-phase short-circuit current. Similar conditions can be derived for double line-to-earth faults by expressing the fault current in terms of 3-phase short-circuit current.

However, for earth faults at points remote from the system neutral, say for a fault at C in Fig. 1 the ratio $K=Z_0/Z_1$ becomes higher, which results in a higher dynamic overvoltage between the unfaulted phases and earth—equations (7) and (8)—but at the same time a smaller earth fault current than the 3-phase short-circuit current.

This is a most important point as the selection of the rating of the surge divertors at their point of application depends on the ratio $K=Z_0/Z_1$. It should be borne in mind that although surge divertors are capable of protecting insulation against impulse voltage (a surge divertor may discharge 100 kA in a micro-second) they require protection themselves against dynamic overvoltages. In order to prevent thermal damage due to the flow of 50 c/s fault current, the gaps of the divertor should be set so that the spark overvoltage is higher than the highest 50 c/s overvoltage due to switching or fault current. Thus correct rating and gap setting will give adequate protection to the surge divertor[3].

In a similar manner, it can be proved that non-effectively earthed systems secure favourable fault current conditions but less favourable dynamic overvoltage conditions.

As regard to transient overvoltages, the application of symmetrical components will prove also as a powerful tool in evaluating the RRRV and the computation time can be reduced considerably by using a transient network analyser. Field tests have proved that calculated values do not differ substantially from measured values[4]. These tests may reveal that the RRRV is extremely high at certain locations, and consequently the circuit breakers become unsuitable for duty because they are not able to deal with these increased values.

For effectively neutral earthed systems the transient overvoltages are less severe because (*a*) the neutral is held, in the event of an earth fault, at a small displacement voltage; (*b*) the electrostatic energy of the unfaulted phases is drained off through the neutral earth connection when the arc is extinguished, and (*c*) the transient is efficiently damped due to the very low earthing resistance.

For non-effectively-earthed systems the transient overvoltage is reduced if the neutral resistance is so chosen that the reactive component of the lagging fault current in the faulty phase is approximately equal to the leading capacitance in the healthy phases, thus reducing the fault current to a small value[5].

Insulated Neutral System

Here the zero sequence reactance is predominantly capacitive, hence the ratio X_0/X_1 is negative. Since the zero sequence resistance R_0 is small compared with X_0 we obtain, from equation (3), $K=-X_0/X_1$. In the event of a line-to-earth fault the fault current is very small as compared with a 3-phase short-circuit current because the sum

of (X_1+X_2) being predominantly reactive, tends to cancel out $(-X_0)$. On the other hand the dynamic line to earth overvoltages of the unfaulted phases may be considerable because of the negative value of K. (See equations (7), (8)). It should be emphasised that in extensive systems the dynamic voltage at locations remote from the fault may be large because of the capacitive nature of the fault current.

From these equations it follows that (assuming zero fault resistance b=c=o) if K approaches −2, that is when the sum of $X_1+X_2=2X_1=-X_0$; or $K=-X_0/X_1=-2$ the dynamic voltage is theoretically infinite. (Series resonance circuit.) In practice this voltage is not infinite due to the presence of resistance but it may rise to a dangerous value if the circuit resistance is small.

As regards transient overvoltages, here the electrostatic energy of the unfaulted phases is not drained off as the arc is extinguished, and in each successive half cycle, are extinction and restriking takes place, accompanied by still higher transients. This voltage, however, will seldom exceed five times the peak value of the phase to neutral voltage[6].

Resonant Neutral Earthing

From equations (1) to (8) it follows if the reactance of an iron-cored coil (A.S.C.) inserted between the neutral point and earth is adjusted to be equal to the system capacitance reactance, the current at the point of fault is reduced theoretically to zero and the dynamic overvoltage between unfaulted phases and earth is increased to $\sqrt{3}\times$phase voltage. In fact the fault current at the fault location is not zero, due to the presence of harmonics and losses in the system. Under perfect tuning conditions the residual current I in the fault is about 10% of the fault current, but can be considerably larger if corona loss is taken into consideration, particularly during periods of bad weather. Despite accurate tuning, the residual current may be large enough to maintain ionisation of the air and consequently may not prevent the extinction of the arc in many instances.

Thus the main advantage of the arc suppression coil namely the slow re-appearance of the system voltage (about 10-20 times as slowly as in solidly earthed networks after extinction of the arc) does not always materialise in e.h.t. systems and this is one of the main reasons why arc suppression coils are not used with such systems.[7]

Finally, it has to be borne in mind if a continuously rated coil is in use and a line-to-earth fault is held for a certain period, the transient overvoltage due to manual switching operation subsequent to the fault removal imposes severe interrupting conditions on the circuit-breaker, because the restriking voltage across the breaker contacts is equal to line-to-line and not phase-to-neutral voltage.

Conclusion

Neutral earthing of power transmission systems can be summarised as follows: For h.v. systems operating at voltages or below 66 kV the limitation of earth fault current is of importance, but not at the expense of unsatisfactory operation of the protective gear or considerable increase of the system insulation level. Generally this is achieved by low impedance neutral earthing. In case of resonant neutral earthing the fault current at the fault location can be reduced to a very small value but the insulation level must be higher than in effective earthed systems. With e.h.v. systems operating at voltages in excess of 110 kV, solid neutral earthing is exclusively used. The problem of clearing transient faults can be solved by the use of high-speed auto-reclosers.

Finally, operation of transmission systems with insulated neutral should be rejected because of generation of high transient overvoltages. In the event of the loss of the system neutral earthing point (assuming no multiple neutral earthing the system operating during disturbance with unearthed neutral) adequate precautions have to be taken to prevent generations of transient overvoltages.

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RULES FOR UNIT TESTING

RECENTLY published by the Association of Short-Circuit Testing Authorities (ASTA), is a publication, ASTA No. 15, which gives rules for the unit testing of circuit-breakers for making capacity and breaking capacity. These rules do not eliminate the tests required by BS 116: 1952, but lay down the basic requirements for testing multi-unit circuit-breakers by units to simulate the full breaking capacity. The main requirements are that the various units of a circuit-breaker shall be substantially identical in size shape and mechanical operation; that in each unit, during breaking operations, the characteristics of the arc extinguishing medium at the contacts shall be independent of the operation of other units; that where extinguishing medium is from an external source, it shall be supplied to all units simultaneously and independently; that exhaust vents or pipes shall have operating conditions independent of the operation of other units, and finally that where voltage distribution devices are incorporated the distribution of voltage between units shall be practically constant under all operating conditions and be practically the same both for recovery voltage and restriking voltage.

It is, however, appreciated that in multi-break circuit-breakers, the voltage across the units, during operation in service, may or may not be equal, depending on the design of circuit-breaker and the conditions under which it may be operating. The determining of the correct unit recovery voltage to be used on test is therefore a fundamental requirement, and in fact provides one of the main problems of unit testing. An appendix gives a method of estimating the values of recovery-voltage for unit tests. The Rules also include the programme for tests for breaking- and for making-capacity. In the former case it is emphasised that the value of unit recovery-voltage shall not normally be less than 95% of the specified value except where testing plant limitations make this impossible. In that case the figure shall be as high as possible but shall not be less than 67% of the specified figure.

It is also laid down that it shall be verified that the peak values of the unit restriking and recovery voltages remain constant fractions of the total voltage to within plus or minus 10%. The reference values of these fractions shall be the mean of the fractions determined during the three tests of a 100% breaking duty, and the highest fraction shall be used to determine the unit recovery-voltage for test. Instructions for dealing with control resistors are also included. The Rules are available from the Association of Short-Circuit Testing Authorities, 36 Kingsway, W.C.2. Price 10s.

INDUSTRIAL MAINTENANCE

A special monthly section of the Electrical Times

Contacts for Electrical Control Equipment

A SUGGESTED SCHEME FOR MAINTENANCE

By J. W. Fair, D.L.C., A.M.I.E.E.

RELIABLE performance of electrically operated plant depends entirely upon correct behaviour of its associated control equipment. Electric contacts are an essential part of this control gear, and failure to make and break circuit when required may cause consequent losses of output or production far beyond those expected.

The correct maintenance of electrical contacts has become of great importance in modern industry. Recent tendencies in the types and designs of control equipment have made the duties of maintenance staff more onerous, for several reasons. Amongst these are the necessity for more compact gear, often causing inaccessibility, heavier duties required from contacts which have to be made of smaller size, rendering essential the use of new and unfamiliar materials; if one adds to this the present supreme importance of avoiding loss of production, with less time available for maintenance and inspection because of continuous shift working, the dilemma encountered by those responsible for organising and carrying out electrical maintenance duties may be appreciated. A further difficulty is introduced by the increasing use of electronic controls which are often fitted with relays of the telephone pattern, having small contacts, with which maintenance staff are unfamiliar.

The following notes result both from experience in organising electrical maintenance, and from an analysis of records of contacts and equipment returned to manufacturers for replacement or repair, together with results of tests carried out under controlled conditions on various types of contacts. Primarily, the comments relate to air-break automatic contactor gear, but will be found useful for similar contact applications in manually operated equipment.

To achieve a satisfactory scheme of contact maintenance, it is necessary to decide the correct answers to the following points, bearing in mind the fact that each case has to be settled finally by the characteristics and duty of its application.

(1) How often is examination necessary?

(2) How can one tell when surface dressing of contacts is required?

(3) What method of cleaning, filing, etc. is correct for various types of contact and contact material?

(4) When is complete replacement of contacts necessary?

It must be emphasised that the rough and ready attention given to heavy copper contacts, such as those used in the past for equipment such as tram car controllers, are quite inadequate for modern automatic equipment, and can only lead to waste of valuable contact material, and possible failure of insulation due to the quantities of dust and metal particles produced. Coarse files, emery cloth, and vaseline, should now be minor items amongst tools used by the modern electrician.

A General Guide

Literature on the subject of electric contacts exists in some quantity, but most of it refers to tests under conditions quite different from those encountered in industry. Furthermore, the information is not in a suitable practical form, and maintenance staff have not the time available for reference to a collection of unrelated data. The best guides to follow in this respect are the instructions issued by the manufacturers of the control equipment, modified by experience of the actual working conditions. However, these are not always available, and it is felt that some general guide might be found useful.

In order to simplify reference, various broad types of contacts are shown in Figs. 1 to 4 inclusive; it is not possible to describe more fully in reasonable space the various patterns and combinations of types used by different makers, but those shown have been selected to give as full a range as possible. In conjunction with a few brief notes, it should be possible to identify any normal type encountered, and from that to find maintenance recommendations from the tables given later.

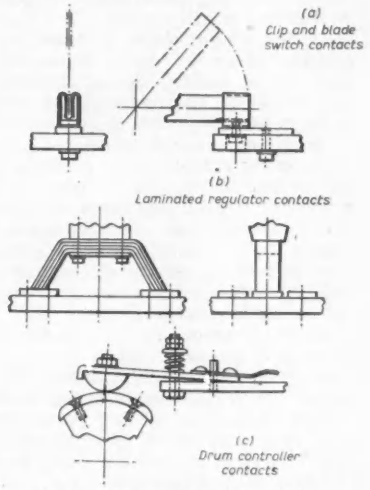


Fig. 1. Contacts for various switches

The contacts illustrated in Fig. 1 refer chiefly to hand-operated isolating switches, main switches, and drum controllers. Materials used are chiefly copper or copper alloys such as brass or phosphor bronze. The laminated or brush type of contact shown in Fig. 1 (b) is sometimes used on faceplate controllers or sliding shunt and series regulators, or in large sizes for heavy currents on air circuit-breakers, protected by auxiliary arcing contacts. Most electricians are quite familiar with these. As they may

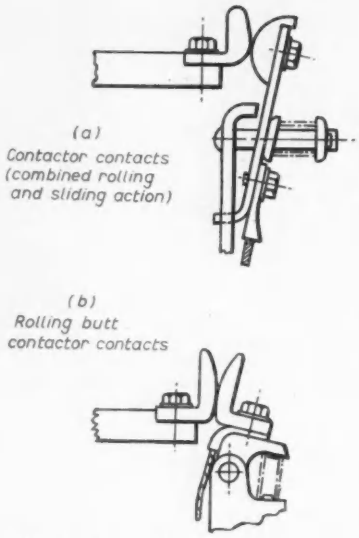


Fig. 2. Contacts for air-break contactors

be said to have a self-cleaning action during operation of the switch, the occurrence of high resistance surface films does not usually cause any difficulty.

Fig. 2 illustrates contacts used on shaft or clapper types of air-break contactors; the material used is chiefly copper, although some modern designs use inserts of silver alloys or compounds, and occasionally sintered copper tungsten for heavy duties where the period of carrying current is short, and switching operations are frequent. Again, the action may be described as self-cleaning. In Fig. 3 are shown various simple pressure butt contacts, which are being increasingly used for the smaller sizes of contactor and for relays. The contacts proper are rivets or discs rivetted or welded or brazed to supports or brackets.

Due to the absence of any mechanical self-cleaning action, the material used must be capable of continued use without forming high resistance surface films or layers. These contacts are also used for auxiliary switches on contactors, and in auxiliary units such as push-buttons, limit switches, etc.

Various forms of auxiliary and control circuit contacts are illustrated in Fig. 4. These are encountered as interlocking contacts on large contactors and in pedal switches, shunt limit switches, and similar gear, as alternatives to those shown in Fig. 3. Copper is the most widely used metal for this particular type.

Contact Materials

When dealing with contacts, particularly those on contactors, it is useful to remember that there are several conditions which are not obvious at first sight, yet which have a great effect on the performance. These characteristics in contact material are: (1) Formation of surface films; (2) Melting point; (3) Hardness; (4) Heat conductivity; (5) Cost.

Dealing with (1), the electrical conductivity of the material is not a reliable guide to its suitability for contacts. The essential point in good contact performance is the ability to resist the formation of high resistance surface films in normal industrial atmospheres, or if such films do occur, that they are easily removed by the action of the switch or contactor. For example, copper forms surface films of quite high resistance, in spite of its very good electrical conductivity; its use for contacts is possible because the films formed are not very strong or stable under normal conditions, and are easily removed by the mechanical action of the contacts one upon another, and furthermore, are affected by heating during service in such a way as to give a lower resistance. Aluminium, although having high electrical conductivity, forms a stable and robust surface film and it is quite useless as material for contacts of any description. Conversely, the great advantage of pure silver lies in the fact that the electrical resistance of its surface films is reasonably low, and there is no

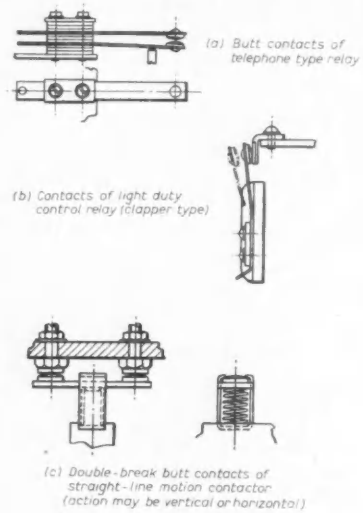

(a) Butt contacts of
telephone type relay
(b) Contacts of light duty
control relay (clapper type)
(c) Double-break butt contacts of
straight-line motion contactor
(action may be vertical or horizontal)

Fig. 3. Pressure butt contacts

need to use any mechanical self-cleaning action to remove it. Alloys and compounds of silver retain this property to some extent, depending upon the proportion of other metals added.

Turning now to (2), a high melting point is desirable to reduce the possibility of contacts welding together when opening or closing circuit. The high temperatures produced will melt the surfaces of the contacts, and obviously the higher the melting point, the less likely is serious welding to occur. In this particular case, silver is inferior to copper. The highest melting point is given by tungsten compounds, but the high surface resistance of these prevents their universal application, and confines them to intermittent duty, and very severe duty where the contacts do not have to carry current for any length of time.

The third property mentioned, that of hardness, is concerned with mechanical wear; to reduce this where a self-cleaning action is necessary the metal should obviously be as hard as possible. Tungsten compounds are the hardest materials, and silver about the softest. Silver is used because, as no self-cleaning action is necessary, the surface wear due to mechanical action is small. Loss of contact material in copper contacts having powerful self-cleaning action may amount to an appreciable percentage of the total loss, hence compromise plays an important part in successful contact design.

Turning now to item (4), a material having good heat conductivity is valuable in avoiding undue temperature rise when carrying current, and also to reduce the chance of welding during switching by conducting heat away from the contact surfaces. Heat conductivity is proportional to electrical conductivity, which means that silver has the highest and tungsten compounds the lowest heat conductivity of the materials normally used. Lack of good heat conductivity in the latter materials may lead to rapid loss in weight by flaking due to excessive temperatures unless careful arrangements remove the heat by the correct mounting on a high conductivity backing. Brass and phosphor bronze also have low figures but are used in large area contacts so avoiding overheating.

Cost, which is the fifth property under consideration, generally works to the advantage of copper, which is the cheapest of the normal contact materials. This means that it is used in spite of other deficiencies, and arrangements to reduce the effect of these are worth while. Although not a great part of the first cost of equipment, costly contacts may lead to heavy maintenance and replacement charges unless the material chosen shows much greater wear resistance than a cheaper alternative.

Of the large variety of metals, alloys and compounds available, those normally used are listed in Table 1, together with brief details of their characteristics. To assist identification, further, a note on their surface appearance is added. However, it must be remembered that metals such as copper and brass are often electro-plated with nickel or silver, and in doubtful cases some unimportant part of the component should be lightly filed to expose the metal below the surface layer.

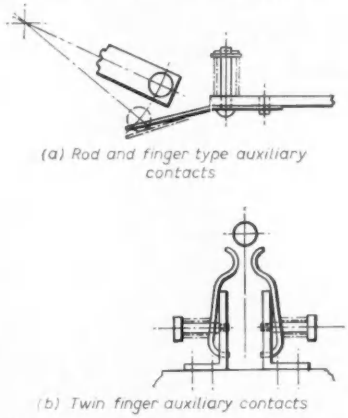


Fig. 4. Auxiliary and control circuit contacts

The information given in this table is not intended for design purposes, nor to suggest alterations to existing contacts, for which the manufacturer should be consulted; the idea is to give briefly information on points likely to help in inspection and correct treatment of contacts in normal service. Replacement of special contact materials on control equipment by makeshift contacts of copper or similar substitutes, is almost certain to cause continuous trouble and eventual failure. It is most important to keep spares of such contacts available, and accessible for immediate use.

Maintenance of Contacts

In all such problems as these, it is most helpful to keep a routine record of dates of inspection, work done on particular equipment, and to decide and keep to a definite frequency of examination. This is important in all planned maintenance work, but it is particularly so where contacts are concerned, since incipient trouble is not obvious externally, and can only be discovered by regular inspection. In contact maintenance the golden rule is "as little interference as possible." Well designed gear allows for a reasonable amount of loss of material from contact faces, and for blackening and the higher resistance due to burning, etc., and opposing contacts tend to bed down from new to a condition which lasts for a considerable time if they are not put out of alignment by unnecessary filing or similar treatment.

The normal contact materials may be grouped under three headings:

(*a*) Copper and copper alloy contacts.
(*b*) Silver and silver alloy contacts.
(*c*) Sintered contacts.

In connection with copper contacts, those of the general type shown in Fig. 1 (a) should be carefully dressed with a fine file to remove globules and pitting, to avoid stubbing and jamming action during operation. They also benefit by slight greasing with vaseline or one of the proprietary contact greases. The copper type brush contacts shown in Fig. 1 (b) should not be used where there is any possibility of burning, as once damage has occurred it is extremely difficult to restore the contacts to a good working condition. It is usually necessary to remove the equipment to the maintenance shop, and to restore the correct pressure and surface action by careful fitting. This again benefits when in good condition by a slight amount of lubrication. In the case of drum type contacts as shown in Fig. 1 (c), these should be kept in order by careful filing to remove globules and pitting, and a small amount of lubrication applied, provided arcing is not extremely heavy. If arcing is heavy, it is usually better not to use a lubricant as the consequent carbonisation causes more rapid wear than is necessary. It is recommended that files, not emery cloth, should be used for dressing contacts, as emery cloth is likely to leave small abrasive non-conducting particles embedded in the surface of the soft copper.

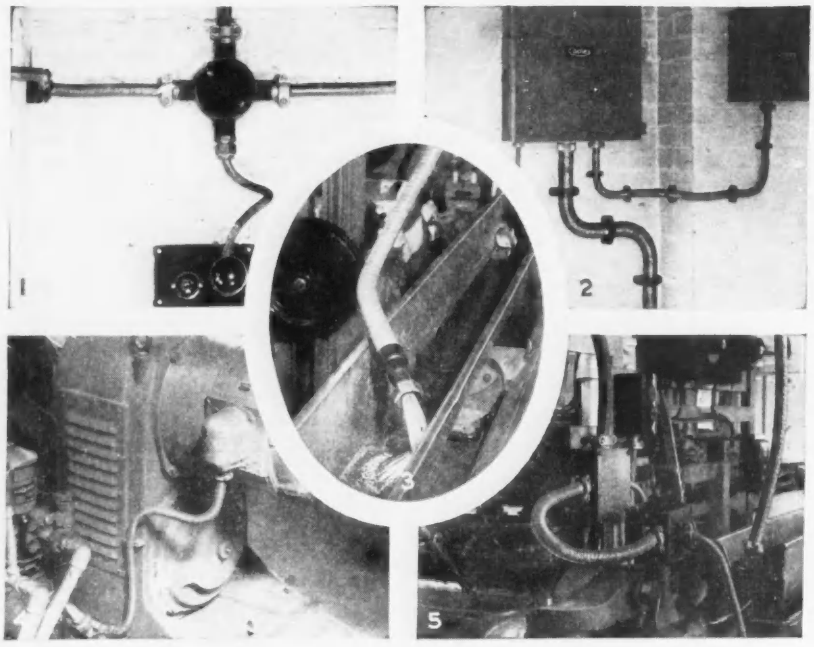
Copper contacts on contactors (Fig. 2), used for normal starting and stopping duty, should not require dressing or filing except after long intervals, when the shape of the contact has been seriously altered by use. Some contactors have an adjustment which allows one of the contacts to be moved to restore the spring pressure to its initial value; this allows full use to be made of all the metal available in the contact itself. Where no adjustment is provided, filing and dressing should be kept to the minimum possible, and contacts must be replaced as soon as the amount of spring lift on closing is reduced, or welding and overheating will be certain to occur. Lubrication of faces is not recommended for contactor contacts, as carbonisation of the grease during arcing usually causes overheating and consequent damage.

The lighter types of contacts shown in Fig. 4 should be lightly lubricated, and any serious pitting or burning smoothed out with a fine file. As they are usually only used for control currents, dressing and filing is not often required, but it is usually advisable to keep the surfaces reasonably lubricated.

Turning now to silver and silver alloy contacts (Fig. 3), these do not require dressing or filing under any circumstances. Due to the cost of the material, the amount used is reduced to the minimum by the designer, and filing only means loss of costly metal. They are de-

TABLE 1.—SUMMARY OF PROPERTIES AND USAGE OF CONTACT MATERIALS

Contact material	*Appearance*	*Characteristics*	*Used on contact Fig. Nos.*
Copper	Reddish "copper" colour showing purple or blackened areas when burnt after normal service. Often plated with nickel for appearance, or with silver to give good contact on mounting surface.	Good general purpose material. Most widely used, but needs self-cleaning action because of occurrence of high resistance surface films. Contact welding may occur on excessively heavy duty.	1 (*a*) (*b*) (*c*) 2 (*a*) (*b*) 4 (*a*) (*b*)
Brass	Naturally yellow. Often nickel or silver plated. Blackens in use.	Forms high resistance surface films and needs cleaning action. Chiefly used for auxiliary contacts dealing with small currents.	1 (*a*) 4 (*a*) (*b*)
Phosphor Bronze	Similar appearance to copper. May be nickel or silver plated. Blackens in normal use.		
Carbon (Metal and Carbon Compound)	Dark grey or black. Generally mounted on clamp type pressed backing.	Does not weld. Suitable for contacts not carrying current for long periods.	1 (*c*) 2 (*a*) (*b*)
Silver (Pure or Fine)	Bright white metal, blackens in normal atmospheres. Used as rivets or facings on brass or copper supports. Blackens and roughens in normal use.	Used when self-cleaning action cannot be obtained. Surface films are not of high resistance and do not cause overheating. May weld on excessive duty.	3 (*a*) (*b*) (*c*)
Silver-Copper alloy (Standard Silver)	Similar to fine Silver.	Harder than fine Silver. Some cleaning action is advisable unless lightly loaded.	2 (*a*) (*b*)
Copper-Tungsten (Sintered Compound)	Dark grey or purple. Used as facing brazed to copper or brass backing.	Does not weld and resists heavy arcing. High surface resistance causes overheating on continuous load. Very hard material.	2 (*a*) (*b*)
Silver-Tungsten (Sintered)	Grey in colour, used in similar way to Copper-Tungsten.	Alternative to Copper-Tungsten, giving lower resistance.	2 (*a*) (*b*)
Silver-Nickel (Sintered)	Similar to Silver. Used as rivets or brazed-on facings.	More resistant to burning and welding than Silver, but has higher surface resistance.	2 (*a*) (*b*) 3 (*a*) (*b*) (*c*)



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signed to operate efficiently with blackened and pitted contact faces. Very small contacts of this type, such as those encountered in telephone relays, should not require any attention except to be freed from accumulations of dust and dirt, which might interfere with the correct action, due to the light spring pressure. These silver types of contacts should be used until the spring compression on closing has fallen to a small amount, and then the contacts should be completely replaced. Under no circumstances should any lubricant whatsoever be used with silver contacts.

The third variety of contact material, comprising sintered compounds, should not be filed or dressed. They are usually very hard, and again due to the cost of the material, the minimum amount is used because of the cost. Generally, their treatment should be similar to that of silver contacts, and lubrication must not be used. Care must be taken to replace the contacts as soon as the sintered facing has worn at all thin, otherwise difficulty will be encountered due to contact taking place on the backing material.

It is possible to evolve from the above remarks a series of maintenance procedures which will cover adequately all the types of contact and materials normally used. Table 2 gives a suggested collection of these, whilst Tables 3 and 4 give a summary of contact types and proposed standard methods of attention for copper contacts and special metal contacts respectively. The use of these suggestions, in conjunction with practical experience of existing gear, may help in improving reliability. In the case of new equipment, if these suggestions are read in conjunction with the maker's recommendations, they will assist in drawing up a preliminary maintenance scheme, which can be modified as found necessary by subsequent experience.

TABLE 2.—SUGGESTED STANDARD MAINTENANCE PROCEDURES FOR CONTACTS

Ref.	*Procedure*
A.	Using medium and fine files, remove globules and smooth out deep pitted areas, sufficiently to allow contacts to operate together without stubbing or jamming. Do not use emery cloth. Wipe off dust, filings, etc., from insulation surfaces.
B.	Clean surfaces with cloth or duster, to remove dust, dirt, or carbon.
C.	Restore contact profiles as much as reasonably possible by careful filing. Wipe away any filings from insulation surfaces.
D.	Check that contact spring is compressed when contacts are closed by observing that lever or rocker is lifted off its stop, so that pressure is fully applied to contacts.
E.	Lubricate contact surfaces lightly with vaseline or special contact oil.
F.	Do not touch contact surfaces in any way.
G.	Lubricate, with thin machine oil, rocker and lever pivots.
H.	Check contact pressures with spring balance.
J.	Check contact pressures with special contact tester.
K.	Replace fixed and moving contacts as soon as spring compression has fallen to minimum specified by manufacturer. (Usually 1/32 in. from initial compressed position.)

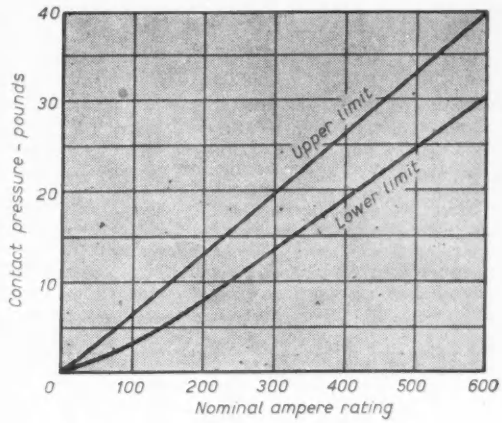

Fig. 5. Contact pressure for copper contacts.

Checking Contact Pressures

Although it is not necessary on normal equipment to check contact pressures, unless the springs have been distorted or damaged, there are cases where it is advisable to do this as a protective measure to avoid future trouble. These cases occur with small relays of the telephone type, and with large contactors of about 150 amperes rating and larger.

With the relay contacts of the general type shown in Fig. 3 (a), the pressure is given by the flat leaf springs on which the rivet is mounted, and occasionally these weaken or are accidentally distorted; it is very difficult when rectifying them to obtain any idea of the actual pressure which is being obtained, unless one of the lever type spring balance pressure testers specially made for telephone contacts is available. If the equipment comprises a number of these relays, it will pay to obtain one of these for maintenance use, as much time and trouble can be avoided. To use the instrument, the projecting lever is placed against the contact face in question, and the adjusting knob altered until the contact can be just lifted with the lever before the latter moves against its pivot. The instrument is usually calibrated in grams and a rough and ready figure for this type of

TABLE 3.—APPLICATION OF STANDARDISED MAINTENANCE TO COPPER AND COPPER ALLOY CONTACTS

Contact Fig. No.	*Contact material*	*Recommended maintenance method (Table 2)*	*Interval between inspections*	*Additional remarks*
1 (*a*)	Copper, Brass or Phosphor Bronze.	A and E.	2 weeks.	Inspect more often if switching on load is necessary.
1 (*b*)	Copper.	B and E.	4 weeks.	If burnt, or well worn needs skilled reconditioning.
1 (*c*)	Copper.	A, C, D, E and K.	1 week.	
	Carbon/Copper.	A, C, D and K.	1 week.	
2 (*a*) and 2 (*b*)	Copper.	A, C, D, G and K.	1 week.	Carry out H for large contactors every 4 weeks.
4 (*a*) and 4 (*b*)	Copper, Brass or Phosphor Bronze.	A, D, E and K.	2 weeks.	Fresh contact surface may be found by loosening and rotating moving contact rod to new position.

contact in industrial service is 50 to 70 grams.

Where heavy contactor contacts similar those shown in Fig. 2 (b), are used, a large amount of surface material can be worn away before the contacts need replacing; this loss of material, however, has the effect of reducing the contact spring deflection, and consequently the contact pressure. The manufacturer's instructions often give the correct spring pressures, and it is advisable in such large units to check when wear has occurred, necessitating adjustment. A simple way is to close the contacts on to a strip of paper held between them, and attach a spring balance to the moving contact or its fixing screws by a wire loop or stirrup. By pulling on the other end of the balance with a steadily increasing pull, the pressure may be accurately obtained by noting the balance reading when the paper can be just pulled from the contacts. As a general guide, approximate limiting values of contact pressure for copper contacts used on conventional contactors are given in Fig. 5. The manufacturers recommendations should, however, be used if they are available.

TABLE 4.—APPLICATION OF STANDARDISED MAINTENANCE TO SILVER, SILVER ALLOY, AND SINTERED CONTACTS

Contact Fig. No.	*Contact material*	*Recommended maintenance method (Table 2)*	*Interval between inspections*	*Additional remarks*
2 (*a*) and 2 (*b*)	Silver. Silver Alloy. Tungsten-Copper or Silver. Silver Nickel.	D, F and K.	1 week.	Carry out H. for large contactors every 4 weeks.
3 (*a*)	Silver. Silver Alloy. Silver Nickel.	B, J, and K.	4 weeks.	
3 (*b*) and 3 (*c*)	Silver. Silver Alloy. Silver Nickel.	F and K.	1 week.	If duty is not heavy, inspection period may be extended up to 4 weeks.

Conclusion

When using the above recommendations, it must always be remembered that the behaviour of all electrical contacts is greatly influenced by the conditions under which they operate, so that an exact general maintenance procedure cannot be laid down. Experience is the only final guide; however, it is hoped that this article will help in deciding on suitable methods for any particular case, and so avoid losses in production time caused by unexpected contact failures.

Some Points about the Electricity Regulations

Part 9

By H. W. SWANN, O.B.E., D.F.H., M.I.E.E.

REGULATION 2 of the Electricity Regulations was being discussed at the end of my last article in this series. This Regulation, I then remarked, was probably drafted as three separate requirements, dealing respectively with the insulation of the conductor, preventing the insulation from being knocked about, and dispensing with the insulation where the conductor was out of reach.

> ELECTRICITY REGULATIONS 1908 AND 1944: REGULATION 2.
> All conductors shall either be covered with insulating material and further efficiently protected where necessary to prevent danger, or they shall be so placed and safeguarded as to prevent danger so far as is reasonably practicable.

One problem that frequently arises in reference to this Regulation concerns the placing of overhead lines, wires and cables in premises where mobile cranes are being used for lifting and transport.

When I have looked at the Regulation in consequence of cases like these I have realised the difficulties of the engineer who has to decide what is "reasonably practicable." Would his Board face the expense of placing lines so sky high as to be clear of the tallest jib, or should he rely on a warning notice to drivers at every place where a line crosses a roadway or track? He may consider trying to teach the drivers to be careful, to floodlight crossings at night, or to erect guard cradles under the lines. Building Associations have endeavoured to assist the Department by issuing advisory circulars to their members but after adding up all these valuable contributions I am inclined to the view that accidents would be far more numerous were it not for the skill shown by many of the drivers in handling their machines. I remember seeing a man take a lift which brought the head of the jib between and above two three-conductor lines strung side by side four feet apart, and then inch the load to one side until I stopped him. He told me he had often done it before and by the look in his eye I should say he has often done it since—in spite of the Duties Clause.

Busbar Distribution

The first internal "busbar" system of factory distribution I ever saw took the form of bare rod carried on insulators fixed as near to the roof as possible. It was claimed that they were safe by position—"so placed as to prevent danger"—and that anyway they were no worse than the crane trolley conductors at a lower level. The down connections, tapped off for supply to machine tools, were insulated and pulled into conduit and I was invited to consider the bus-run as an internal overhead line.

It seemed evident that so long as nobody used a ladder, the arrangement satisfied the Regulation, but the roof lights seemed fairly clean and the high power lighting reflector fittings were not so bad either. I asked if I could have a closer look at the conditions up aloft, meaning from the crane girders, but the maintainance staff produced an extension ladder at once from alongside a neat pile of scaffold planks. Since then it has been generally recognised that supply to a machine shop cannot be switched off for window cleaning, relamping, painting, structural repairs and such like, and so these very adaptable systems of busbar distribution have been boxed with provision for tapping, safety being achieved under the first part of the Regulation by "protection" instead of making an ineffective attempt to do it by position or "placing."

Crane Trolleys

The question of crane trolley conductors is on a rather different footing. Taking first the most general case of the indoor travelling crane, spanning say an erecting shop, many of them are supplied on d.c. systems at less than 250 V and thus Regulation 2 ceases to be operative under the terms of Exemption 1. Where the d.c. voltage is higher, or where 3-

phase supply is utilised at mains voltage, positional protection, which is the only practicable course, must be effected not only by fixing the trolleys well out of reach but by the adoption of a supervised routine under which nobody is allowed to go near the trolleys unless the latter have first been switched off. An interruption in the crane working does not compare with the dislocation which would follow shutting off a system of busbar distribution and in a great many factories the routine required in connection with crane trolleys has become well established. A crane trolley switch, which can be locked off, is the first essential, the second being to settle who is to have the key.

ACCIDENTS INVOLVING ELECTRIC CRANES

Year	Crane Trolleys		Crane Drivers	
	Fatal	Non-Fatal	Fatal	Non-Fatal
1930	3	16	1	10
1935	2	18	1	11
1940	7	28	1	20
1945	5	30	1	16
1950	5	26	—	17
Ten Year Totals				
to 1940	36	144	8	132
to 1950	52	296	15	185

There is justification for the growing appreciation of the need for ordered routine in connection with crane trolleys because for many years there has been a steady death roll. When I started the little accident classification tables in my first annual report of 1930, I provided two categories for crane trolleys and crane drivers respectively and it has been a source of great regret to me that they have always had to be used. An analysis over 20 years shows that the total number of trolley accidents during the ten years ended 1950 was substantially greater than in the preceding ten years to 1940 and in any one year an average of four lives are lost. In 1943 which was a bad year all round there were ten fatalities. One driver loses his life every year and in an attempt to find out why, I have often been up to their cabins, or cages. They seem to me to live rather apart and to have their own sense of values as to electrical risks. They kept an anxious eye on me if I started clambering about, although I might be doing no more than use the same ladders and gangways that they themselves traversed daily. It was not unusual, in the early years of my official life, to find that there was no considered or constructed way of access to a crane cabin and more than once I had to dodge under the trolleys or walk alongside them on a plank. I believe I got a good many landing stages built with fixed access ladders and where the trolleys could be touched from the cabins I asked for screens, but it was difficult to protect the driver who tries to oil the trolley wheel collectors whilst they are live. This goes also for the transverser, or crab, where there is much less excuse for not switching off, as the control should be in the cabin or near by.

Many of the accidents result from mistakes. An electrical fitter comes along to do a job on the crane and first switches off. The driver takes the opportunity to go off somewhere and presently the fitter comes down also to get another tool or take some accessory to the fitting shop to repair it. The driver comes back, finds someone shouting for a lift, switches goes to see where the fitter has got to, on for it, and then comes down again and The latter returns, goes up to the crane thinking it is still switched off and resumes his job. This was a fatal case I remember investigating myself, but it is typical of many others which, with variation of detail, lead to accidents. The permit to work, and ordered routine which can be effective in a large organisation is difficult to introduce into a relatively small concern and thus it is from these places that many of accident notifications are posted.

Low Level Wires

I have had some awkward cases in connection with indoor telphers, or travellers, running on a single girder overhead track. In a particular instance the occupier had seen the handy little electric trucks, operated from a lower trolley wire, which grace some of the larger brickworks, and had put in a very low telpher rail, the trolley conductors being carried on the side of the girder within easy reach from the floor. It seemed to me far from being protected by position as the Regulation requires, but the occupier intimated that he thought I might offer advice first to the brickworks which had been there long before he started. I had in fact done this many years before and the little trucks were, I knew, operating at 220 V d.c. whereas the telpher had been arranged for 3-phase a.c. at mains voltage. We nearly reached one of those unfortunate impasses where occupier and inspector part to meet again under the auspices of the Crown. The telpher was quite new and I could well understand the occupier's reluctance to improvise a box guard over the trolleys, with a slot for the collector arm, even if it was possible to fix it round the sharp curves, which seemed more than doubtful. In the event we both managed to shelter under the kindly umbrella of Exemption 1, by having the telpher motor re-wound for 110 V and transforming down for the trolleys.

The necessity of boxing or screening low level trolley or bar conductors arises also at coke oven plants and can be especially difficult where it has to be improvised as an afterthought. In the more modern plants, where the point is in mind at the design stage, it is usually possible to protect the conductor bars by the structural mountings at back and top, the actual screenwork being limited to a front guard. The bottom is left open for the collector supporting bracket and provided the protection gives reasonable overlap at this point the arrangement appears to meet the Regulation. If, however, the coke oven tractors have to pick up from both sides, which is unusual but sometimes necessary, the disengaged collectors may remain live and unprotected on one side of the tractor whilst those on the other are engaged under effective cover.

Lengthy Tools

Protection of conductors by position can be defeated by stacking of materials and also by the use of long steel tools such as are common on coke oven plants. I once saw a man raking a furnace in a gas works retort house where trolley wires were supported on the wall opposite to the retorts. Every time he drew the tool back he brought it to within inches of the trolleys and I asked him how he managed to gauge it so nicely. He said I should soon learn if I had to do his work, an answer which makes me think he might have had some experience. The foreman said it was a "hot tool" and then I realised that the stoker was using hand pads. I thought I would get the manager's opinion and I then found that the risk had passed unnoticed, an unusual omission in a gas works, and suitable guards were promised.

This concludes the notes on the Electricity Regulations which Mr Swann, formerly H.M. Senior Electrical Inspector of Factories, prepared specially for the ELECTRICAL TIMES. *An historical review of the origin of the Regulations appeared in the issue of* 24 *Dec.*, 1953, *and subsequent articles were published in the Industrial Maintenance Special Section on* 21 *Jan.*, 18 *Feb.*, 18 *Mar.*, 15 *Apr.*, 24 *June*, 15 *July*, 19 *Aug. and* 16 *Sept.*, 1954.

Crane Wire Prosecution

A CASE decided early this year illustrates the point made in Mr Swann's article about crane collector wires. Painting of roof supports was in progress at a factory occupied by the N.C.B., and pending the erection of scaffolding two men were instructed by a leading hand to start painting steelwork accessible from the roof of a store. Soon afterwards, one of these men was electrocuted from overhead crane collector wires running close to the steelwork to be painted. The N.C.B. was prosecuted on the grounds that a switch which controlled the supply of electrical energy was not so worked as to prevent danger. Defence counsel argued that no responsible person had instructed the men concerned to go into a position of danger; that had their presence been known, the wires would have been made dead; and thus, that the men got into a position of danger which could not reasonably be foreseen. The magistrates found the case proved, however, and this decision was upheld on appeal to Quarter Sessions. There, the Chairman said that there had been a lack of supervision: the occupiers could have made the area safe by switching off the current. He did not call for a reply on the interpretation of "reasonably practicable."

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Danfoss Type LRVT 65A Contactor Starter

DATA SHEET 10

THIS starter, the first continental unit to be examined on these data pages, is made by a Danish firm, the Danfoss Manufacturing Co., specifically for the direct starting of 3-phase motors up to 40 h.p., with a current range of 7·5 amp to 65 amp. This firm is also well known for its refrigerator control accessories.

The starter, as illustrated, is made in one size with a choice of 4-heater trips and can be supplied in either dust-proof case with knock-outs, or watertight c.i. case with openings for alternative flange fittings. (A similar starter is also manufactured by this company with a range of 0·2 amp to 15 amp covering h.p.s up to 10.) These starters are virtually miniature editions of that under consideration.

Fuses should be fitted before the starter.

Construction

The dust-proof model is mounted on a pressed steel base of channel form, the vertical turn ups (the top and bottom of the starter) each being provided with 3 knock-outs: ¾, 1 and 1½ in. The housing cover carrying the stop and start buttons, shrouds the whole starter, with the exception of the knock-out ends. The cover has slots which engage 4 fixing screws, two at the top and two at the bottom.

This main channel frame has 3 bosses to carry the mechanism and a steady boss on the upper part on which the thermal overload rests. The channel form provides exceptional facilities for wiring and allows any back nuts or bushes to be freely tightened up without the side of the case being in the way.

The starter itself consists of 3 sections:

1. At the bottom, the solenoid unit, on top of which is mounted:
2. The contactor in a ceramic shroud which is surmounted by:
3. The overload release unit.

The Solenoid Unit. This unit, unlike those in some starters, is entirely visible, of robust construction with a gravity controlled armature. The stampings are riveted to a small back plate provided with 3 screw holes, through which pass 3 resiliently mounted screws (G) fixing the unit to the starter base plate.

The 2 coil contacts are easily reached for testing purposes. The armature is extended into a tongue which passes through the top of the iron core and carries a moulding with one screw fixing (E) on which is mounted the 3 main phase contacts and an auxiliary contact (rated at 2 amp 500 V) at each end (K and D), which can each be arranged to make or break contact.

The contactor closes with 75% of full voltage and opens when the volts drop to 65% of normal. The coil consumption at the moment of starting is 275 VA and in the run position 43 VA (10 W). The shading rings are completely visible.

The bottom of the armature carries a mechanical flag (H) bearing the legend O and H, visible through the cover of the starter, for stop and start respectively. Care must be taken to avoid bending this flag while servicing the unit.

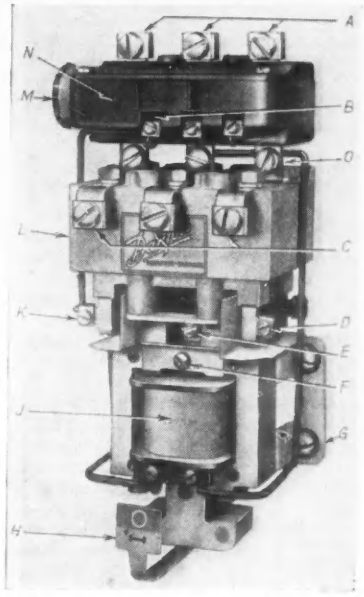
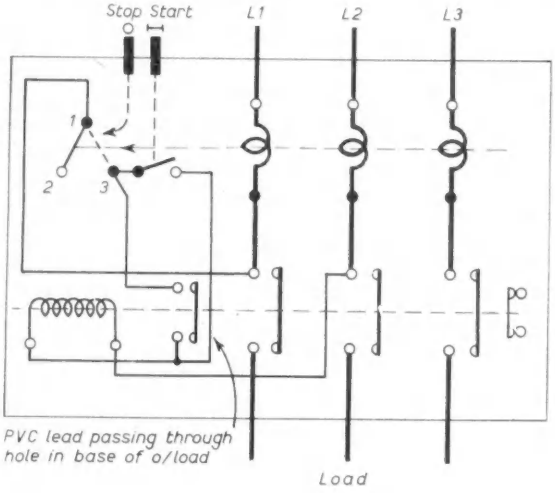
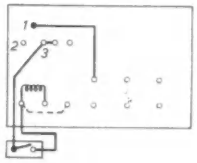
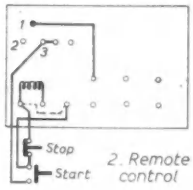


Fig. 1. 65A Contactor. Letters are referred to in text

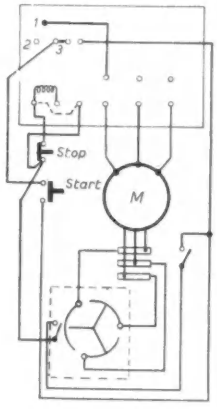




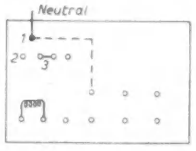
1. Remote control



2. Remote control



3. Remote control with interlocks



4. Coil voltage phase-neutral Remote control as 1, 2, 3

In all cases remove - - - -

Fig. 2. Immediately above is shown the normal connection diagram for the starter. On the right are some special connections for use with remote control

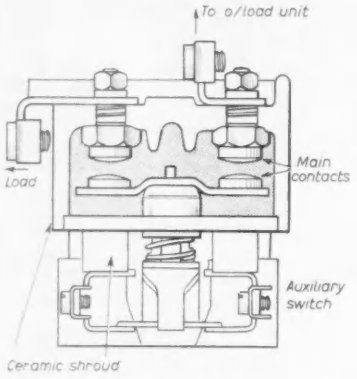


Fig. 3. Section through contactor unit

SPARE PART NUMBERS FOR DANFOSS 65A LRVT CONTACTOR STARTER

Supply	Thermal release No.	Amps	Max. fuse in line	In c.i. case	In dust proof case	Thermal release unit
220/50 V 50 c/s	6	7·5–15	35	45–126	45–146	45–046
	7	14–25	60	45–127	45–147	45–047
	8	24–42	80	45–128	45–148	45–048
	9	40–65	100	45–129	45–149	45–049
380/440 V 50 c/s	6	7·5–15	35	45–136	45–156	45–046
	7	14–25	60	45–137	45–157	45–047
	8	24–42	80	45–138	45–158	45–048
	9	40–65	100	45–139	45–159	45–049

Spare parts: Coils 220 V 50 c/s 45–013; 380 V 50 c/s 45–014; Other supply conditions 45–015 (state details). Moving contact carrier 45-005 ; ceramic base 45-318 ; ceramic cover 45-317 ; aux. contact 37-3191 ; aux. contact spring 37-3193 ; aux. contact spring cup 37-3182. Fixed contact 45-311 ; moving contact 45-003 ; moving contact spring 45-029 ; moving contact spring cup 45-313.

The Contactor. The contactor (L) is entirely shrouded by ceramic material, the double break silver-tipped contacts operating in their own respective cells. These contacts are of the circular, domed variety, and self bedding. The top of the ceramic shroud carries the 3 load terminals (C) and the 3 terminals connecting to the overload release unit (M).

Considering the current capacity the contactor is very small 3¾ in. by 2¾ in. by 1½ in. and each of the 3-phase contacts is completely shrouded in ceramic material. It is shown in section in Fig. 3.

The Overload Unit. This self-contained unit of moulded construction (N) is mounted on top of the contactor unit by the 3 input contactor terminals, each of which is slotted for this purpose.

The top of the overload unit bears the 3 input terminals R, S, and T, (A), and the unit is shown in detail in Fig. 4. In this drawing the inspection lid has been removed, together with the rear cover which carries the 3 terminals R, S, and T. These terminals are connected by flexible leads (4) welded to the bimetal strips.

This type of trip relies on the expansion of a bimetal strip, one in each phase, in event of overload. The resulting movement (individual or cumulative) is conveyed via a trip bar (5) to the trip gear contained in a separate cavity. Through the front of the unit pass the stop and start push strips which are operated by the press buttons on the cover.

The trip itself, like other similar mechanisms on the market, relies on a type of "dead centre" effect, the position of the rocker being determined by the operation of the start or stop buttons. Similarly the position of the contact strip (7) is also governed by the position of the trip bar (5).

The drawing (Fig. 4) shows the starter in the "off" position with the contact strip (7) making the single circuit contact (10) connected to terminal (2), i.e. in the "off" position without being tripped. When the start button is fully depressed the linkage moves, contact (8) is made momentarily and contacts (9) made permanently with the strip (7) to the terminal (3).

When overload occurs the trip bar (5) allows the contact strip to break circuit from terminal (9) and makes on the signal, i.e. warning circuit, contact (10), connected to terminal (2). The starter cannot be reclosed until the bimetal strips cool and return to their normal position.

The 3 terminals (numbers 1, 2 and 3 on Fig. 4) and also marked capital B in Fig. 1 are not easily seen since they are moulded on the lower side of a cavity containing the terminal strips.

The adjustment knob M alters the position of the arm (11) and also the position of the trip bar (5).

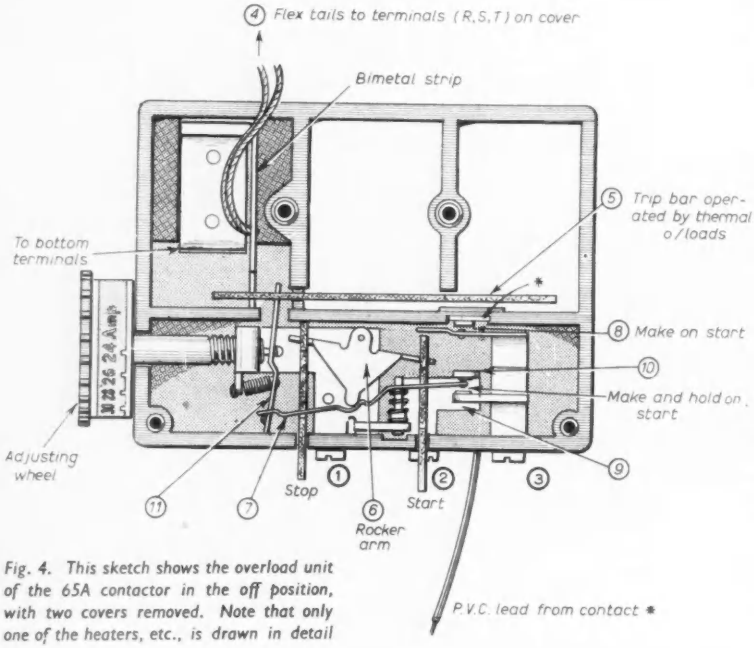


Fig. 4. This sketch shows the overload unit of the 65A contactor in the off position, with two covers removed. Note that only one of the heaters, etc., is drawn in detail

Servicing

As with all these modern contactors, there is very little to be done beyond keeping the mechanism clean, replacing worn phase contacts and ensuring that the magnet faces are free from rust.

Dismantling and replacing parts. It was explained on the previous page that the 3 units are added one on top of the other; hence dismantling will begin with the removal of the top unit, i.e. thermal overload, by slackening the 3 screws (O). It will also be necessary to disconnect the p.v.c. auxiliary circuit leads.

The Contactor. This can now be reached and dismantled by unscrewing 4 round-head screws sunk below the ceramic surface. The fixed contacts are attached to the top of the arc shroud and the moving contacts are bayoneted on to the moulded extension of the armature. Removal of the 3 moving contacts and the p.v.c. lead connecting to the left hand auxiliary contact, enables the contactor base to be withdrawn leaving the contacts moulding clearly visible. This is held by one screw (E) and housed to the armature tongue.

The armature itself is now free.

The Coil. Unscrew (F), remove spring cheek and lift out coil. Take care that the two guide plates on either side adjacent to the shaded poles are not lost.

Belts, Pulleys and Bearings

by K.W.

IT is not generally appreciated that apparently trivial things can cause a considerable amount of damage to a small motor. The normal drive is by V-belt and these are generally excellent and a vast improvement on the old type flat belt which are always so troublesome on short centres. There is, however, a tendency to fit aluminium pulleys in place of the more usual cast iron to many f.h.p. motors, with the result that the drive-end bearing can fail very quickly, due to the heat generated by the slight slip of the belt being rapidly conducted by the aluminium to the motor shaft. One firm of refrigerator makers has called in all aluminium pulleys as a result of this trouble and is replacing them with the cast iron type.

Since most refrigerator motors have resilient bases with integral tensioning device, the belt is automatically adjusted but the fixed resilient base can always be maladjusted, frequently with too much belt tension, and damage can again be caused to the drive end bearing by overloading. This trouble is insidious, since the pull of the belt keeps the shaft to one side of a badly worn bearing and still allows the motor to run reasonably quietly until the bearing eventually collapses and the rotor fouls the stator stamping with disastrous results. Similarly, a fixed base motor with the belt too slack will again suffer damage by the heat of slip. The correct tension of a belt appears to be a matter of experience.

V-belts are supplied in a variety of widths and the substitution of a belt by a wider one may also damage the motor, because the effective diameter of the pulley is increased and consequently the load on the motor is also increased in proportion. This is especially the case when the drive is V to flat, i.e. V-pulley on the motor and a flat pulley on the driven machine.

Since small motors are normally supplied with a plain shaft, the bearing, coupling, pinion or dog drive must be fitted by the user or, more frequently, by the fitter responsible for the installation. Most fitters are well aware of the precautions necessary in such an operation and yet many pulleys are badly fitted. A pulley or coupling, should slip on easily before the key or, more frequently, the Allen screw is tightened up, and any force used in driving on a tight part may not only upset a bearing but can also cause incorrect operation of the centrifugal gear or the switch if the motor is a single-phase machine. Violence can also cause other troubles, e.g. movement of a sleeve bearing. This is easily done in some small motors, and excessive end play will result. This may lead to an internal fan rubbing on the windings, since in some cases the normal clearance between the fans and the windings is very small. Even more serious trouble can be caused in some machines and the rotor stampings actually move along the splined shaft and become out of line with the stator. Such a fault might be considered to be a purely hypothetical example but they occur quite commonly.

In this connection, it should be remembered that many small motors and dynamos have a parallel splined shaft with the stampings pressed on up to a pre-determined point and often without any locating shoulder. Any slight variation in the stamping hole, or, more likely, in the splining of the shaft, could easily allow the shock of drifting on a pulley, to drift the shaft through the stack. Movement depends on which way the stampings were pressed on the shaft. The stampings dish slightly in the centre and form a series, as it were, of lock washers permitting comparatively easy movement in one direction only. If this direction coincides with the motion due to tapping on a pulley, the stampings may move under violence.

Loose rotors are occasionally found which are not due to this maltreatment, but to a maker's fault. They can give some very misleading symptoms while the motor is running.

Fixing of Pulleys

In small motors there are four normal types of shaft: 1. Plain, 2. Flat on shaft, 3. Parallel key, 4. Woodruff key. In the first of these, the fixing of a part to the shaft is probably by an Allen screw and for the small h.p. under consideration is normally quite satisfactory. If however, the motor is subject to prolonged periods of sudden stopping and starting under a maximum load, this fixing is certainly not suitable, and a key is necessary. Moreover the screw, biting on the shaft, will raise a small burr which must be eased off before the motor is dismantled for repair, otherwise the bearing will be scored on removal unless the shaft is reduced in diameter after the journal. (The same point applies to the parallel and Woodruff keys.) The use of flats on shafts certainly avoids this difficulty and is a very popular method of finishing shafts, but is still not suitable for snatching loads.

The Woodruff key is probably the easiest to fit but is not so common on f.h.p. motors as the parallel key. Here the key should be fitted with care. It need not be more than a light tapping fit since it is usually located by an Allen screw immediately above it. It is often wise to leave a little of the key head projecting if it will not foul anything, and also to avoid fixing a pulley so close to the motor end plate that the pulley cannot be withdrawn with a standard pulley drawer. After all, some poor fitter will have to remove both some day, so some thought for him is desirable.

Lubrication

Lubrication is another very simple job that can also give trouble. In the first place many sleeve bearing motors are supplied dry by the makers and the oil reservoir must be filled before putting the motor into service. In such cases the oil is usually supplied in small capsules. If not, a light oil similar to B.B. will suit, but a recommended grade should always be used, if possible.

Do not use a very light sewing machine oil or such oils as "3 in 1." While these oils are excellent for some purposes they are usually too thin for most normal motor duties and if used the oil may creep and cause failure of any internal switch plate by fouling the contact points.

Once correctly charged, a sleeve bearing in an f.h.p. motor on intermittent duty in normal temperature, will not require attention for a year or so. Alternatively a continuously operated motor will require a few drops every month or so. Replenishing is not always easy in spite of the provision made by the manufacturers. In refrigerators, for example, the drive end of the motor, with a fan and pulley close to the condenser, the normal oiler cannot always be reached and if the oiler is of the spring ball type it might be impossible to add lubricant without a special oil can.

As a result of the extreme difficulty in reaching these drive end bearings many fitters have deliberately ignored the lubrication of them — with obvious results. Alternatively, if a motor is in for service, many fitters will prise out the spring ball lubricator to get over this snag but it may lead to additional trouble by releasing the spring tension on the oil wick. This spring tension is essential in a sleeve bearing to keep the wick in contact with the shaft.

The extended oil tube fitted to many motors is better in the showroom than in the job, since so many of them become damaged in installing and the tube becomes flattened.

Sleeve bearings, after being in use for some years, particularly so in motors on intermittent duty, require the wick to be cleaned or replaced.

To illustrate this point, a large slow speed fan on the roof of a cinema, which failed to start, may be considered. It was removed, with considerable difficulty, from the roof of the building for workshop examination, and stripped, examined and the winding and capacitors (a single-phase machine) carefully tested. Everything appeared to be in good order and when re-assembled the motor ran normally. Since the problem was not solved the motor was again stripped and the bearings examined. These were P.B. sleeve bearings 3½ in. long by an inch bore. The journal was very good but the wick had become somewhat stiff with congealed oil and moreover there appeared on the shaft a slight impression of the oil way, etched as it were by the minute amount of acid presumably present in the oil. This was the final answer to the problem since the motor, in an inaccessible position, received no servicing and was not used during the winter months. The culminating feature was the fact that it was a single-phase motor and noted for its poor starting characteristics and this, coupled with the slightly congealed oil in the bearings, was sufficient to prevent it starting.

Congealed wicks of this nature can be removed, washed in petrol and re-oiled before refixing. In this connection it should be noted that Messrs B.T.H. supply hanks of wick material, suitable for all kinds of motors, at a very reasonable price.

The abrasive action of certain types of oil wicks should not be overlooked since they can cause considerable wear on the shaft. This wear is particularly the case in earlier motors of small sizes and especially desk fans where the lubrication, somewhat primitive, is supplied by a brass cap oil reservoir and a round felt feed wick, spring loaded on to the shaft. Long use with this type of lubricator may result in the shaft being almost cut through by the wick.

In all cases excess of lubricant should be avoided. It may not damage the winding itself since many of the varnishes used are unaffected by oil, but the flexible leads, mainly rubber-insulated with cotton braid, will be seriously damaged in course of time. The rubber swells, oozes out through the cotton cover, leaving little insulation on the conductors. One type of motor, made by a very large and reputable English firm, is very prone to this trouble because the switch lead, i.e., the lead from the switch-plate to the terminal block, is rather loose and rests on the end-plate near the bearing where it receives any small trickle of oil, perishes and shorts to earth.

Although this article does not deal with ball bearings, it is as well to remember that here too, an excessive amount of grease will cause the bearing to run hot.

Most f.h.p. motors are now fitted with white metal bearings in a thin steel shell but many still use the ordinary P.B. bearing. Should the oil well in a P.B. bearing run dry the shaft is very apt to seize up solid in the bearing and it may require considerable force to part them. In such cases the shaft picks up metal from the bearing and small particles of bronze become welded to the journal surface. After such treatment the motor usually requires new bearings but sometimes, especially in an emergency, the shaft can be recovered by hand treatment in a lathe, using a dead smooth file followed by polishing with "wet and dry" paper—always preferable to emery for such jobs.

On the other hand the white metal bearing does not suffer to any such extent from this "picking up" since the soft metal tends to conform to any irregularities in the journal.

Pitted Bearings

On rare occasions a shaft may be found with the journal covered with a reticulation or a network of fine etched lines. This etching is due to a leakage of current from the rotor to the earthed bearing and by inference the rotor in this example would be a wound rotor.

This leads us to another point.

At the moment of starting a rotor, the shaft is in metal contact with the bearing, but as soon as the shaft revolves and oil is circulated, a film of oil is maintained around the shaft and, theoretically, there is now no metal to metal contact between the journal and its bearing.

According to Dusenbery, the thickness of the oil film to maintain this condition and support the weight of the shaft should not be less than ·00075 in. With this consideration in mind it follows that the greatest leakage of any rotor current to earth will occur when the motor is just switched on.

Once up to speed the rotor should, with good bearings, be partly insulated from the frame.

Ring Oiled Bearings

As far as f.h.p. motors are concerned the ring oiled bearing, with one certain exception, is obsolete; not because of its efficiency as a bearing, but because of its unsuitability as an item in a modern mass produced article which must be, as far as possible, foolproof and requiring little attention. It must not be assumed from this statement that the ring bearing is liable to trouble. Indeed a well-designed ring oiled bearing, using the correct oil and oil level, may last for 20 to 30 years with very little attention. When these bearings were designed their size was often generous for their duty and assuming an equally generous allowance for air gap clearance, it is easy to see the reason for their long life. On the other hand the modern wick oiled sleeve bearing is subject to a much heavier duty with a thinner metal shell and a definite limit to the permissible wear governed by a very small air gap.

The exception mentioned above, while perhaps not strictly applicable to f.h.p. motors, but rather to small motors generally, is when silence is desirable; hence fan, lift, organ blower motors, etc., are frequently supplied with this type of bearing.

The following points should be watched:

1. The oil level of the bearing must not be too high, otherwise oil will be lost by creepage and it may damage any associated electrical gear. It is the normal practice to fit an overflow/filling hole to these bearings so the correct level is easily found.

2. The ring must be smooth and true since it rotates by friction and surface tension on the shaft. Many old motors may gradually develop a small flat or radius on the inner surface of the ring and this flat can prevent the rotation of the ring and the lubrication of the bearing. Most rings are endless, that is machined solid, but occasionally a split ring is found with a hinge joint and pin fixing. These hinge joints are very likely to develop flats on the hinges and prevent the ring rotating.

3. The oil ways in the bearing, and particularly the drain holes in the end of the bearing and housing, must be kept clean.

4. The oil reservoir must also be kept clean because sludge is liable to settle there after long periods.

5. The oil slings on the shaft, the usual knife edges, must always be clean and sharp, and:

6. These knife edges, the last one of which usually acts as a thrust shoulder, must not undercut the bearing.

7. The oil, journal and oil well must be kept free from any abrasive dirt to prevent scoring of the shaft.

Since it is often useful to give examples of any subject under discussion, the following trouble may help to illustrate one of the more obscure points.

The ring oiled drive end bearing of a 1 h.p. repulsion - start induction - run motor developed a habit of failure every few months. On two occasions the bearing was replaced and the shaft cleaned up, to be followed with the complaint that the oil would persist in draining out and frequent replenishment was necessary. Naturally, following a complaint like this, the bearing and shaft were carefully examined and everything was found to be apparently in order. In view of the loss of oil, the oil return holes drilled through the cast iron housing were especially examined and found to be in order. The motor was next given a long bench run and, sure enough, the oil dribbled away down the inside of the end plate and subsequent examination found the trouble. The inner face of the cast iron housing originally had a pressed brass ferrule which acted as an additional oil return baffle. This had become loose, ridden along the shaft and had become wedged, and completely hidden, inside the centrifugal gear on the drive end of the rotor windings. Such a simple answer to a troublesome problem.

METER ENGINEERING AND ECONOMICS

Chairman of I.E.E. Measurement Section discusses economic limit of accuracy

IN an address devoted to a brief physical and descriptive treatment of electricity meters, Mr M. Whitehead, M.I.E.E., the chairman of the I.E.E. Measurements Section, spoke on a subject which has long been the concern of his Section. To some, perhaps, his choice of subject may have been considered narrow, to which Mr Whitehead put the obviously correct answer that by a deep investigation into a specialised subject, the engineer becomes involved in an increasing number of associated subjects which can only result in a widened experience. On the other hand, those (among whom Mr Whitehead obviously counted the younger engineer) who aimed at obtaining wide experience were open to the danger that that experience must necessarily be shallow.

After this brief opening preamble, attention was turned immediately to the subject of the Address, which in its most elementary concept required the production of a driving torque proportional to power to drive a rotor, and consequently a braking torque proportional to the rotor's speed. From this point, it can be said that a disc is set in motion when it is cut by two alternating magnetic fluxes displaced in space and time. Analysis, however, then proceeds along two different paths, determined by the acceptance of either the revolving field theory, or the interacting field theory, as the basis for producing motion. Whatever method of analysis is employed, however, the designer is still confronted with the difficulty of calculating the torque and force set up to produce motion of the disc. In effect the problem is the determination of the current in the disc, and can be solved by employing the descriptive method of images and inverse points. This enables the current flow in a meter disc resulting from a long filament of flux to be estimated and, by successive modification, to take into account the actual flux shape and leakage flux.

Accuracy

The foregoing discussion leads naturally to a determination of errors, introduced by non-linearity of the iron magnetisation curves and disc-currents distorting the main field. Over the normal speed range, whilst the braking force of the permanent magnet may be considered proportional to the speed, those forces due to the current and voltage fluxes may be considered as proportional to the cubes of current and voltage respectively and hence are responsible for most of the errors in current and voltage characteristics.

Probably the most important characteristic of a meter is the range of power with variable current, the ratio of maximum to minimum current over which acceptable and stable performance is obtained being thus a paramount criterion. Although long range may be obtained, it is only at the expense of stability, experience having shown that a stable lowest load is associated with a driving torque at this point of 0·2 gm cm. On this basis, an examination of the extension of measuring ranges of the last 40 years shows no trend towards finality and hence that further improvements may be expected.

Finally, there comes the economic problem of equating technical performance of meters with their cost; with the necessary and correct assumption that the supply industry must continue to use meters for its existence. With a system supplying a large number of consumers, it is only in their interests that the specified accuracy of metering is required. The supply authority interest is met by a lower accuracy because only the effective accuracy of groups is concerned, and as the distribution of metering errors would follow a Gaussian curve, high and low errors would largely compensate each other. Such meters would still meet the desire to ensure equitable distribution of charges between meters, whilst their mere existence would serve to check wasteful consumption.

Between these two interests lies the most economical meter performance. It is suggested as the accuracy, which, whilst setting a positive limit of meter error, ensures that the consumer pays a minimum charge. By reducing the accuracy of metering the consumer's payment for energy will be high by the extent of the positive error. On the other hand, the cost of metering, as a result of the use of poorer accuracy meters, will be reduced, and the consumer's actual payment, when adjusted for the reduced metering cost, shows a minimum when the error lies between 1% and 2%, which represents the economic level.

New Materials in Engineering

WEDNESDAY of last week saw the chairman's address to the I.E.E. Radio Section, in which Mr C. W. Oatley, M.A., M.SC., M.I.E.E., took as his theme the effect of new materials on the work of the electrical engineer. In this connotation, however, the engineer is he who is largely concerned with light current work, for the chairman was concerned largely with non-metallic solids and conduction of electricity through them, the service which is the basis of modern transistor developments.

The basis of conduction through non-metallic solids, is, as is now well known, the positive hole caused by valency electrons which, due to an external agency, have left their parent nuclei to move freely through the crystal lattice of the solid. Like the electron, the positive hole is available to conduct electricity. The external agency may take a number of forms, such as a rise in temperature, bombardment by electrons or alpha particles or as photons of radiant energy, but all involve the addition of sufficient energy to dislodge the electrons normally bound to nuclei. In a few cases, the energy required to produce ionisation of the pure substance is less than one electron-V—germanium is a good example—but in many impure substances the ionisation energy of the impurities is quite low, and these substances are semi-conductors. When they are heated the number of free carriers are increased, the basis of the operation of the thermistor.

An example of a non-metallic crystal becoming conducting as a result of the absorption of radiation is the selenium cell and since the war cells similar to this have been developed for detecting infra red radiations. Here the active material is a layer of suitably treated lead sulphide, lead selenide or lead telluride, and such cells are about 100 times more sensitive than any other known detectors. Another device exemplifying this conduction is the zinc-sulphide screen which, in early nuclear physics research, was used to count alpha particles by the scintillation produced as they hit the screen. Although this method of counting is now obsolete, the mechanism by which the scintillations were produced provides an indication of the means by which phosphors in fluorescent lamps are excited. Electroluminescence is a further example of conduction in non-metallic solids. Such is the present development that a case for including some of this new fundamental knowledge in university courses seems to be well established.

Alkyd Moulding Materials

A RECENT development of considerable importance to the electrical industry is the commencement, in this country, of full-scale manufacture of alkyd moulding materials, thus placing at the disposal of the British plastics industry a range of materials for producing components with, in many cases, electrical properties superior to those of conventional phenolic moulding materials. Marketed under the trade name of "Plaskon," these alkyd moulding materials are being produced by Resinous Chemicals Ltd., Blaydon-on-Tyne, Co. Durham, under licence from the Barrett Division, Allied Chemical and Dye Corporation.

The basis of their moulding compounds are alkyd resins, which, being unsaturated polyesters, become thermosetting in the presence of suitable catalysts. Suitable catalysts are supplied incorporated with the moulding material. On moulding, the cross-linking which then takes place is an addition polymerisation having the advantage that low weight by-products (characteristic of phenolic powders) are not produced. From the electrical aspect this feature is particularly important as the formation of water, produced in moulding conventional powder, does not occur and hence the difficulty raised by its removal in conventional moulding does not arise, with especial benefit to the electrical properties of the moulding. Moreover, from the moulding aspect, the curing of A.M.C. is a chain reaction, which, once initiated, cannot be stopped, with a consequent substantial reduction in the time required for this process. Of the five compounds marketed, one has a glass filler whilst the remainder have a mineral filler. Included in the latter are two of putty form suitable for moulding around delicate inserts at low pressures.

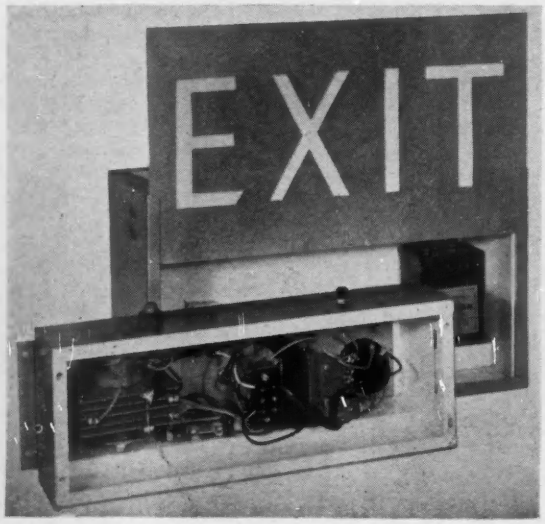
From the electrical standpoint, these alkyd compounds after moulding possess particularly important properties, of which one of the more outstanding is its resistance to arcing and tracking. In view of these qualities, alkyd mouldings are eminently suitable for use in heavy duty power control equipment, motor starters and protective relays, quite apart from their value in aircraft equipment, effecting substantial savings in size as a result of the smaller clearances made possible by their use. In practice, moreover, alkyd mouldings behave better than phenolic mouldings under humid conditions although their general insulating properties are much the same. Data given by Resinous Chemicals Ltd. state that their alkyd mouldings have a dielectric strength greater than 350 V/mil, a volume resistivity over 10^{13} ohm cm and surface resistivity over 10^{12} ohm cm (when tested in accordance with the requirements of B.S. 771: 1954) and dielectric constants and power factors, of 6·0 to 6·2 and 0·05 to 0·06 at power frequencies, of 4·8 to 5·0 and 0·016 to 0·018 at 1 Mc/s and of 4·4 to 4·6 and 0·017 to 0·019 at 3,000 Mc/s.

In comparison with phenolic mouldings, alkyd mouldings have somewhat superior physical properties, particularly in impact strength, whilst their high temperature resistance is distinctly improved. Water absorption, ranging from 0·11 to 0·16%, is also claimed to be lower than any other thermosetting plastic material in general use. Resistance to chemical attack from organic and inorganic materials is also high, whilst the glass filled material is recommended as particularly suitable for washing machine agitators being (like other alkyds) resistant to detergents and having a high mechanical strength.

EMERGENCY EXIT LIGHTING

IT is required in the Home Office Public Safety Regulations for places of public entertainment that illuminated "Exit" signs, as well as signs for doors not giving egress to the street, should be provided with a reliable system of secondary lighting as an alternative to the main supply. The most reliable method of achieving this has hitherto been by the provision of a battery-operated secondary system. This requires considerable expense and fairly high maintenance charges. A "self-contained" system, complying with Home Office regulations has, however, been produced by GB-Kalee Ltd., Mortimer House, 37-41 Mortimer Street, London, W.1.

Rectifier and sign box of the Secundalux Mk II



This unit comprises an "Exit" box connected to a.c. mains. A primary lamp is continuously lit by direct supply, but in addition there are two secondary lamps powered by a 2 V dry accumulator which is constantly charged from the mains through a small transformer and a metal rectifier. The secondary lamps also remain alight while the sign is switched on. Should, however, the mains or the primary lamp fail, the two secondary lamps will continue to burn for a period of over ten hours. The rectifier unit is mounted on top of the sign box, the battery being contained within it.

The unit is known as the "Secundalux" Mk II and measures 16½ in. wide, 12½ in. high and 6½ in. deep. It is fitted with a sheet of white opal glass and stencils worded "Exit," "Way Out," "No Exit" or "Emergency Exit" are available. A small green indicator light in the rectifier box shows when the accumulator is on charge, and a special key switch is fitted to prevent the public from unauthorised tampering. This switch can be operated from the ground. The primary lamp is a 15 watt 250 V d.c. Pygmy sign type, and the secondary lamps are sturdy filament 2 V 0·85 amp units as used in miners' cap lamps.

Price of the sign with "Exit" in white is £16. 16s. (ex works London). "No Exit" or "Way Out" are 8s. 9d. extra, "Emergency Exit" is 12s. 3d. extra, colour filters can be provided for 8s. 9d. extra.

Ferranti's Edinburgh Laboratories Opened

A SCOTTISH CENTRE OF ELECTRONIC RESEARCH AND DEVELOPMENT

THE growing importance of electronics in industry and defence has led Ferranti Ltd. to embark on the building of an extensive design and development laboratory block at Crewe Toll, Edinburgh. This building, which is the result of co-operation between the Scottish Council (Development and Industry), the Ministry of Supply, the Admiralty and Ferranti's is destined to be the focus of a scheme the basic function of which is to allow large scale development projects to be sub-contracted to smaller teams. The purpose of the central establishment is to extend the provision of guidance and training in the field of electronics so that firms, new to this type of work could themselves become knowledgeable in the new sphere under the stimulus of Government development projects. In order that this scheme could be effective, it has been arranged that Ferranti Ltd. can accommodate in the laboratories increasing numbers of engineers from other companies who can gain the necessary knowledge and experience. Advice also will be freely available to management on selection of staff and the handling of Government work from an administrative and contractual point of view.

Work in Hand

At the opening, performed last week by the Duke of Edinburgh, a tour of some of the investigations in hand was arranged. The ground floor instrument laboratory was largely devoted to investigations on gyroscopes and to gyroscopic gunsights. Apart from this laboratory, however, there are also a dust-free room with a separate pillar foundation included, and climatic and durability testing chambers.

In the application laboratory on the first floor, a demonstration showed the Ferranti system of using a digital computor for the translation of drawing board information into the actual three-dimensional movements of a machine tool. This system is based on the use of high precision ruled gratings. On the same floor there are also a standards laboratory, a technical library and a drawing office.

The second floor is mainly devoted to the development of radar and navigational equipment, while on the roof are the necessary aircraft aerials and ancillary equipment. In all there are 24 project laboratories with attached offices as well as drawing offices, dark rooms and all auxiliary facilities.

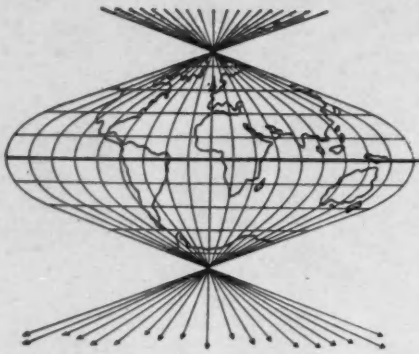
Opening Speeches

Lord Bilsland, chairman of the Scottish Council, speaking at a luncheon which preceded the opening, said that five years before, the Council had sought to establish in Scotland a growing electronic industry, and had been fortunate in receiving the support of the Ferranti organisation in their plans. He paid a tribute to the Minister of Works and particularly to Sir Vincent de Ferranti, as well as to the service chiefs and industrialists who had made the event possible. It had been a unique and unprecedented example of co-operation, with major possibilities in both national defence and industrial activity. In this connection he stressed the magnificent response of the Ministry of Supply, a response which was still further demonstrated by the attendance at the luncheon of the Minister, Mr Duncan Sandys.

The actual opening ceremony was performed by H.R.H. The Duke of Edinburgh before a distinguished gathering. The Duke urged the need for continued research both for peace and defence, and believed that it was to the brains of the electronic engineers that this island must increasingly turn to for its protection. In peace, too, he said, industry must make goods more efficiently and more competitively, and here the electronic industry had much to offer particularly in the fields of process and machine control. From this new laboratory and this unique partnership there would go out trained electronic engineers to help the industries of Scotland and to give security to Great Britain.

Sir Vincent de Ferranti welcomed the Duke and other guests. He recalled that sixty years ago his father came to Edinburgh to give a lecture on electricity. On that visit he was introduced to Mr Bruce Peebles, who had previously a business for making gas. Mr Peebles was so interested in what he heard that he decided to enter the electricity industry. In co-operating with Scotland, the firm of Ferranti felt they were paying back in some measure the great assistance which was given to the industry by the premier Earl of Scotland, Lord Crawford, grandfather of the present Earl, by his experiments in the '80s in lighting the Grosvenor Gallery. That had made possible the demonstration by Sir Vincent's father of the first high-voltage a.c. supply system in the world—a system which had become so widespread and commonplace that it was hardly possible to believe it had to be pioneered against considerable opposition. He paid tribute to Mr J. N. Toothill, the firm's general manager, for initiating the scheme and to the co-operation of the Scottish Office, the M.o.S., Admiralty and the Scottish Universities.

The Duke of Edinburgh speaking at the opening of the Laboratory. Left to right in the front are Mr. Duncan Sandys, then Minister of Supply; Lord Bilsland; Sir Vincent de Ferranti; Lord Provost John G. Banks; The Earl of Home; Mr. J. N. Toothill, gen. manager of Ferranti's



OVERSEAS NEWS

A SUMMARY OF IMPORTANT EVENTS

CANADA

Work in Newfoundland

Further development work is shortly to begin in Newfoundland. The United Towns Electric Co., which, with its subsidiaries, has generating capacity totalling over 16,000 h.p. supplying some 140 Newfoundland communities, is launching an expansion programme, estimated to cost $4 millions, at the request of the Provincial Government. This will include the development of a new hydro-electric power plant at New Chelsea or some other source recommended by the engineers of the Power Corporation of Canada Ltd. The plan also provides for the completion of the 38 kV transmission line from Bay Roberts to Seal Cove to enlarge and improve service to towns of Conception Bay, Trinity Bay and Placentia Bay. Extension of the electric system along the southern shore as far as Renews by the end of Mar. next, and filling of the gap between Hant's Harbour and Old Perlican along the south shore of Trinity Bay is also proposed.

Weyburn Rejects Offer

The offer of the Saskatchewan Power Corporation to take over the electricity undertaking of the city of Weyburn, to which we referred on 7 Oct., has been unanimously rejected by that council after careful consideration. At the same time the council decided to proceed with plans to purchase additional generating plant. Announcing this, the mayor, Mr J. H. Staveley, said the estimated cost of these extensions had been reduced from $350,000 to $250,000. Boilers had been found which could be purchased at a reasonable figure and a good offer had been received on a used turbine.

Kemano Expansion

An order has been placed for a fourth 150,000 h.p. generating unit for the Kitimat-Kemano project of the Aluminium Co. of Canada Ltd., it is stated. The Canadian General Electric will provide the generator and the Dominion Engineering Co. the water turbine. Initially, the move is said to be aimed at providing a larger spare supply of power at the Kemano generating station. But it also means that when Alcan decides to boost Kitimat's capacity for making aluminium above the first 91,500-ton stage it will be able to get new potlines into production months faster.

U.S.A.

Mica Tariff

Representatives of the United States' mica fabricating industry have recommended at a meeting with Government officials at Washington that the latter support proposed legislation to reduce the existing tariff rates on unmanufactured and uncut mica block and film. The industry representatives said that competition was being felt from countries with low labour costs, whose shipments of cut mica to the U.S. has been increasing for the past four years. Instead of increased import duties on mica manufactures, the industry recommended that a bill be introduced early in the new Congress to reduce the duty on unmanufactured mica and uncut mica films and splittings to four cents per lb regardless of value or thickness. The American industry suggested that this rate should apply to block mica valued above 15 cents per lb—on which the present duty is two cents per lb plus 15% ad valorem—and to mica films and splittings—on which the present duty is 20% and 12½% respectively.

ARGENTINE

New Line Wanted

The Argentine Ministry of Industry and Commerce has called for tenders for the erection of a 132 kV transmission line from the hydro-electric plant at El Nihuil dam, in the Province of Mendoza. This new power plant is shortly to be put into operation. The transmission line, to be 244 km. in length, is to be carried on 665 galvanised steel towers.

BRITISH GUIANA

Power Scheme

A large scheme to supply electricity to all the coastal areas of British Guiana is being considered by the colony's Government, it has been announced. The scheme, which would cost ten million British West Indies dollars, would benefit more than 300 miles of the coastline of British Guiana, particularly the town of New Amsterdam. It is hoped that the new power would enable the bauxite ore mined to be processed into aluminium in the colony, instead of its being shipped to Canada for processing, as at present. We reported on 29 July last, that a scheme for supplying electricity to British Guiana's coastal area had been brought to light as the result of a proposal from an outside organisation which was seeking a franchise for a large area.

SWEDEN

Another Scheme

The Swedish State Power Board is planning to erect a new power station at Jarkvissle, on the Indal River, in North Sweden, which would have an installed capacity of 82,000 kW. There would be two Kaplan turbines. The plant, which would be completed in about four years, would have an estimated annual output of 390 million units. Estimated cost of the project is put at Kr. 72m.

S.W. ASIA

Further Railway Plans

As soon as the electrification of the railway lines near Calcutta is taken up, the Lucknow-Kanpur line is also to be electrified. This statement was made recently by India's Railway Minister, Mr Lal Bahadur Shastri.

Wire for Burma

Aluminium Wire and Cable Co., Ltd., are supplying 1,600 miles of steel-cored aluminium conductor for the first stage of an extensive rural electrification scheme in Burma. This conductor will be erected by Crompton Engineering Co. (Madras) Ltd. on the Pegu-Myingyan and Pegu-Allanmyo sections of a new 33 kV grid system which will be fed by diesel power stations.

AUSTRALIA

More Steam Plants?

The Queensland Government is now investigating the possibility of constructing a new steam power station on the Blair Atholl or Callide coalfield within the next two years, Mr H. N. Smith, the State Electricity Commission, stated recently. He added that the question of power stations on coal fields was a matter that had received the attention of the State Electricity Commission for some time. Blair Athol is 650 miles from Brisbane, and Callide is 400 miles from Brisbane and 80 miles south of Rockhampton. Mr Smith said Commission officers had investigated the Herbert River, near Ingham, for a possible hydro-electric scheme. A report was being pre-

pared for the Government on the area's potentialities, he said, but this would be a long-range project for consideration when existing power facilities were overtaxed. Mr Smith said the Tully Falls hydro-electric project would be completed towards the end of the year. The project would supply electricity to northern centres, including Cairns, Innisfail, and Atherton. It could result in interconnection of the Cairns and Townsville Regional Electricity Boards' areas.

Development in S.A.

The Electricity Trust of South Australia has intimated that its programme of work for the Lower Eyre Peninsular this year will cost about £250,000. Of that sum £211,000 is allocated as the first instalment of work on the Kirton Point turbo-alternators, two of which will have a capacity of 2,500 kW. Extension of transmission lines to Yeelanna, North Shields and Poonindie had been examined and estimated costs prepared, while extensions to Lipson and Ungarra are in the planning stage. The Trust is ready to proceed with the main transmission lines and will work on small schemes concurrently.

Victoria's Expenditure

Yallourn power station extensions and open cut coal development will absorb nearly £8 million of the £26,200,000 loan funds which the State Electricity Commission of Victoria, Australia, plans to spend on capital works this financial year. Capital expenditure last year reached £28,200,000, the Assistant Minister, Mr Scully, stated in the Legislative Assembly recently. He said electricity supply extensions would take £4,300,000: the Morwell project £3 millions; Kiewa hydro-electric project, £2,500,000; the new Eildon power station, £1,300,000; main Kiewa-Yallourn-Melbourne transmission lines, £2,600,000; and power stations, £600,000. Another £3 millions would be absorbed by interest charges. The Government had allocated £5 millions, and the balance required would be raised by commission loans and Self-Help loans, together with depreciation and other funds taken from the commission's own resources. But he emphasised that the Commission's programme for 1954-55 still depended on the money being available.

Expansion in Victoria

A further scheme of the State Electricity Commission of Victoria, has been announced. Giving details of this £1½ million six-year scheme for supplying the Wimmera with electricity, Mr Galbally, the Minister of Electrical Undertakings, said work would start immediately on a 66 kV transmission line from Ballarat to Horsham, with the aim of making electricity available to people in an area of 11,000 sq miles. The Commission would acquire the existing Horsham power station and operate it until a supply was available from the State system.

Better Lighting for Perth?

Street lighting in Perth, Western Australia, was worse than in any of the other capital cities in Australia, according to a report from the Illuminating Engineering Society of Australia (W.A.), which has been sent to the Minister for Works, Mr Tonkin. The report has been prepared at the Minister's request after I.E.S. representatives who waited on him to ask for Government action on better street lighting for Perth. It has been suggested that the Government provide finance, if necessary, to assist local authorities with lighting, and that there should be a qualified street lighting engineer attached to the Main Roads Department.

NEW ZEALAND

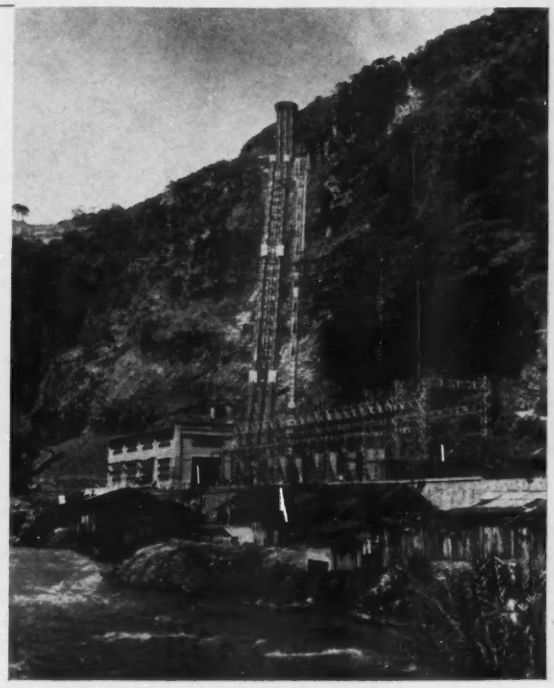
Power Plans

The New Zealand Cabinet has considered the question of starting two further hydro-electric projects in the North Island, Mr Holland, the Prime Minister, has revealed. But he emphasised that the Government were faced with a works programme which had caused resources to be fully stretched. With a programme involving the expenditure of over £60 millions there were not enough men available. Commenting on the two more power projects for the North Island, the Prime Minister added that there was the further scheme at Nelson, and when the Roxburgh project was in commission the South Island would be all right for a few years. But he thought any scheme to generate power in the South Island and transfer it to the North Island was "just crazy." Incidentally, we also have news that over the past two years, the North Island has increased its demand for electric power by more than one-third. In 1952, the amount of power used each week was 48 million units—last year, it rose to 55½ million units. Today, the average weekly consumption is 66¾ million units.

JAPAN

Atomic Power Plans

The Japanese Government has decided to start construction work on a small experimental electric power plant using atomic energy within the next five years, it is reported from Tokio.



The construction of a new 45,600 kW hydro-electric generating station at Patla, on the Necaxa River, for the Mexican Light and Power Co., is nearing completion. It is expected that the three Allis-Chalmers units will be in normal operation within a few days. The addition of this new plant will bring to 211,000 kW the total capacity of the plants of the Necaxa System, located to the North-East of Mexico City, in the State of Puebla. Water from the five reservoirs of the Necaxa System, with a total storage capacity of 171·2 million cu metres, is used first in the 115 MW Necaxa plant and subsequently in the 45 MW Tepexic station. The same water is being used again in the Patla power house, where it is brought from the Tepexic tailrace through a 6·2 kms long tunnel, 3·60 metre dia. It is estimated that about 185 million units will be generated at Patla in an average hydraulic year. The installation of this new plant made it necessary to build two new 220 kV transmission circuits to take energy from the Necaxa Division to the main load centre of the M.L.P. System, at Mexico City, 150 kms away. These 220 kV circuits will carry approximately 75 MW each. The remaining power of the Necaxa Division will be carried by the two existing 85 kV circuits. Two terminal substations, with an installed transformer capacity of 200 000 kVA each, have been built at the terminals of the new transmission line: "El Salto" substation, at the Necaxa end, will serve to step-up to 220 kV the power received via the 85 kV transmission circuits from Necaxa, Tepexic and Patla. The "Cerro Gordo" substation, at the Mexico City end, will step-down from 220 kV to 85 kV the power transmitted by the new transmission line

Personalities

IN THE INDUSTRY

Hoover Ltd., announce that **Mr J. Simpson** has been transferred from the position of district manager at Watford to a similar post at Hendon. The new district manager at Watford is **Mr A. R. H. Dell,** who was previously a supervisor and an instructor in one of the company's sales-service training schools.

The Minister of Fuel and Power has re-appointed **Alderman J. W. Mitchell,** J.P., as a part-time member of the North Eastern Electricity Board, and **Mr Robert James,** O.B.E., WH.SCH., D.I.C., M.I.MECH.E., A.R.C.S., in a similar capacity with the South Wales Electricity Board.

Ekco-Ensign Electric Ltd, have appointed **Mr A. Taylor** as their representative covering certain parts of the Manchester area. He will operate from the company's Northern sales office at Kent St Works, Preston.

At the National Conference of the Purchasing Officers' Association held recently at Harrogate, **Mr O. A. Pallett,** chairman of the A.E.I. Group Purchasing Committee and Supervisor of Purchases, British Thomson-Houston Co., was elected vice-president of the Association.

In charge of sales in the East Anglia area for Laurence, Scott and Electromotors Ltd, **Mr A. C. Hawer** has retired after 22 years service with the company. Ill-health has compelled him to retire earlier than would otherwise have been the case, we understand. Mr Hawer originally joined Laurence, Scott and Co. in the Switchworks Drawing Office in 1905. He left the company in 1921 and spent some years with the English Electric Co. and B.T.H. Co., on switch and control gear design, rejoining Laurence, Scott and Electromotors Ltd, in 1932 to take up the position he held until his retirement. He is succeeded by **Mr C. A. Bendall,** who joined the company as an apprentice in 1936 and has subsequently been engaged on technical sales work in the Birmingham and Leeds areas. Mr Bendall went back to Norwich about a year ago to understudy Mr Hawer prior to the latter's retirement.

Mr William Graham Bush has retired from the board of Sangamo Weston Ltd.

Mr J. G. Goodliffe

Mr A. J. Betts

Mr N. Care

Works manager of Nettle Accessories Ltd, **Mr James G. Goodliffe,** has been appointed to the board as works director. Apart from a short break, Mr Goodliffe has been with the company for a period of 16 years.

Mr R. S. Wren has been appointed a director and secretary of Pope's Electric Lamp Co., Ltd. He joined the company 21 years ago. After experience in various branches of the sales organisation he was appointed sales manager and secretary in Jan. 1949 and he became manager and secretary of the company in Nov. 1953.

Mr A. J. Betts, A.M.I.E.E., has been appointed general sales manager of Enfield Cables Ltd., and will be responsible to the sales director for the company's home and overseas business. Since early in 1952 he has been the company's home sales manager, and assistant to the associate director of home sales. He served his apprenticeship with English Electric Co. Ltd., and in 1937 joined Johnson and Phillips as a switchgear sales engineer. He transferred to their Birmingham branch in 1946, and joined Enfield Cables Ltd. the following year as area manager for the Midlands and South Western Counties.

Assistant chief engineer (distribution) with the Midlands Electricity Board at headquarters, since 1951, **Mr N. Care,** M.I.E.E., is relinquishing that position at the end of November, and is joining South Wales Switchgear Ltd. from 1 Dec. as personal assistant to the general manager, located at the main factory at Blackwood, Mon. Mr Care has represented the Midlands Board on several national panels, including a Switchgear Committee for 132 kV and above, and the Transformer Committee for 1 to 15 MVA. He received training with the Distribution Department of the Midland Electric Corporation for Power Distribution Ltd., and with the Generation Department of the City of Birmingham Electric Supply Dept. After holding a number of positions in the district and head office organisations of the Birmingham undertaking, he was appointed in 1936 to the position of design and development engineer, and in 1944 to the post of technical engineer. During that time he was responsible for the design and development of the Birmingham distribution networks and for the specification and installation of electrical equipment associated with Hams Hall "B" and Nechells "B" power stations. With the nationalisation of the supply industry he became deputy sub-area engineer in Birmingham and in 1951 was promoted to distribution engineer at Board h.q.

Resident engineer at Marchwiel power station, North West, Merseyside, and North Wales Division of the B.E.A., since 1950, **Mr C. Nunn,** A.M.I.E.E., has retired after completing 40 years' service.

Mr A. C. Hawer

Mr C. A. Bendall

Mr R. S. Wren

Mr D. P. M. Laing, A.M.I.E.E., Western district engineer, Glasgow sub-area of the South West Scotland Electricity Board, who is 61, retires on 8 Nov. on completion of 40 years' service. He served his apprenticeship with the Mirrlees Watson Co., Ltd, from 1907-11, and with The Fairfield Shipbuilding and Engineering Co., Ltd., Glasgow, 1911-12. From 1913-14 he was an improver with Mavor and Coulson Ltd, and after a few months with William Beardmore and Co., Ltd, entered the services of the Glasgow Corporation Electricity Department in 1914 as engineer-in-charge in power and substations. During the 1914-18 war he held a commission in the Royal Air Force. His technical education was obtained at the Royal Technical College, Glasgow, and at Paisley Technical College. He was appointed a mains engineer in 1937, and after nationalisation was nominated Western district engineer in 1948. Well-known as a vocalist, he was a pioneer broadcaster with the B.B.C. and broadcast in the first public radio transmission in Scotland which was transmitted by the Marconi Company's engineers under the sponsorship of the Daimler Motor Company, before the B.B.C.'s 5 SC station opened in 1923.

Mr D. P. M. Laing

The Rt. Hon. Arthur Creech-Jones, a part-time member of the Southern Electricity Board, has resigned from that position on being nominated as a candidate for Parliament. The Minister of Fuel and Power has appointed **Councillor W. H. G. Button** and **Alderman G. C. A. Mann** as members of the South Eastern Electricity Consultative Council. **Alderman W. L. Lorkin,** A.M.I.E.E., and **Mr M. Lane** has ceased to be members of the Council. The death occurred recently of **Alderman E. A. Hayler,** C.C., of Hove, who was also a member.

Mr A. E. Millard, left, receives the gifts from Mr Davies

A traveller well known to electrical contractors and retailers in the South of England, **Mr W. Bowthorpe** recently completed 50 years' service with the General Electric Co., Ltd. To mark the occasion **Mr Leslie Gamage,** vice-chairman and joint managing director, made a presentation on behalf of the Company, when our accompanying photograph was taken. Mr Bowthorpe joined the G.E.C. in 1904 and began his career in the Fittings Department, which was then housed in Upper Thames St. After five years there and in the Company's Head Office, at that time in Queen Victoria St, in 1909 he became a country traveller for the whole of Southern and South Western England. Apart from 4½ years war service, Mr Bowthorpe has continued to represent the G.E.C. in the South ever since. From 1922 he has operated in Kent and Sussex, concentrating more recently, as the company's representation in the South has increased, on Sussex.

Mr Leslie Gamage makes the presentation to Mr Bowthorpe

Mr Kenneth Cork has been elected a director of the Radio and Television Trust Ltd. **Captain C. R. Cook** has resigned from the board.

Four new appointments have just been made by the Stanton Ironworks Co. Ltd. They are, **Mr G. R. Buckley,** as general works manager; **Mr E. Morgan** as general manager in charge of research; **Mr L. Rawlins** as commercial manager, and **Mr J. D. Hickman** as export manager.

Mr W. T. Clarke, works manager, and **Mr A. Wilkinson,** works foreman, with Premier Lamp and Engineering Co. Ltd., have been presented with a cheque for £100 and a television set respectively, by Mrs R. L. Woosnam, wife of the managing director, Mr R. L. Woosnam, in recognition of their 30 years' service. On behalf of the employees Mr Clarke was also presented with a wrist watch, and Mr Wilkinson an electric fire.

The fifty years service with Walsall Conduits Ltd. of **Mr A. E. Millard,** managing director of the company, has been celebrated by the employees this month. Mr A. E. Millard commenced his career in 1904 at the then Walsall Hardware Co., as office boy, and after some years became general manager at the new and larger premises in Ablewell St, Walsall. In 1929 the whole of the manufacturing side of the company was transferred to Excelsior Works, Dial Lane, West Bromwich, to join the Tube Mills and part of the Iron Foundry which were already there. When the company was made public in 1936 Mr A. E. Millard was made managing director and since that date the business has continuously expanded until it now employs approximately 1,000 people, and has 35 sales depots throughout the British Isles. To commemorate his lengthy service, Mr Millard has been presented with a handsome silver tray with cut-glass decanters and glasses which were subscribed for by all employees of the company. The presentation was made by **Mr Jack Davies,** foundry manager, who has worked with Mr Millard for the whole of the fifty years.

British Insulated Callender's Cables Ltd. announce the following board changes and appointments effective from 1 Dec. next: **Mr W. H. McFadzean,** chairman and chief executive, will become chairman and managing director; **Mr D. W. Aldridge** will become deputy chairman; **Mr H. J. Stone,** deputy chief executive, is to be general manager; **Mr W. C. Handley** will become deputy general manager; **Dr L. G. Brazier,** director of research, will become director of research and education; **Mr R. M. Fairfield** will be appointed to the board as director of production and engineering; and **Mr D. T. Hollingsworth** will be appointed to the board and will give up his present position as chief engineer to take up an important appointment in an associated company.

OBITUARY

Mr Ainsley Cook, who died on 3 Oct, aged 76, was one of the original members of the staff of Electromotors Ltd, when that concern was founded more than fifty years ago, and became a director, in charge of sales. Shortly after the amalgamation of the company with Laurence, Scott and Co., Ltd., he joined the Norwich staff of Laurence, Scott and Electromotors, Ltd., where he took charge of the rapidly-growing A.C. Estimating Department. Mr Cook was due for retirement when the last war began, but remained at work until after the end of hostilities, and then continued to spend some time in the service of the company on special technical investigations until he was taken ill about two years ago.

Mr H. J. Deacon, M.I.MECH.E., M.I.P.E., a member of the General Manufacturing Department of Standard Telephones and Cables Ltd, died on 29 Sept, aged 56. He joined S.T.C. at the end of 1923 after a period with Fraser and Chalmers Engineering Works, and he contributed much to the work of establishing the system of cable factories which produced the European telephone cable network.

Mr W. H. Palmer, who was section engineer of the Transmission Department of the Central Electricity Board at Rotherham for some years, died recently.

Mr B. E. Evans, proprietor of Standard Accumulators (Ireland), died recently, aged 57.

Mr H. W. Leonard, who died on 7 Oct, served with the General Electric Co., Ltd., for 36 years. He was a senior member of the G.E.C. Publicity Organisation, and for many years held the position of space buyer, from which he retired in Sept. 1946.

Mr S. J. R. Allwood, A.M.I.E.E., who retired a year ago from the position of principal assistant (electrical) to the mechanical and electrical engineer, British Railways, London Midland Region, Derby, died on 1 Oct., aged 65.

Mr J. Bloome, A.M.I.E.E., who has been on the engineering staff of J. D. Crozier and Partners, consulting engineers, for the past eight years, died on 16 Oct., aged 53.

Mr J. J. Ireland, manager of the Grantham district of the East Midlands Electricity Board, died on 17 Oct., aged 51. After attending Thetford Grammar School, Mr Ireland joined Laurence Scott and Co., Ltd., at Norwich as an apprentice in 1918, and continued with the company as an electrical draughtsman until 1928. During the next five years he gained experience with Clarke, Chapman and Co., Ltd., British Thomson-Houston Co., Ltd., and W. T. Henley Telegraph Works Co., Ltd. In 1933, he joined the Mid-Lincolnshire Electric Supply Co., Ltd., as assistant engineer at Lincoln, becoming district manager of the company at Grantham in 1945. He was appointed manager of the Grantham district of the Board in 1948.

Mr J. Walton, F.I.A.C., manager of the Tamworth district of the East Midlands Electricity Board since 1948, died on 16 Oct., aged 56. Mr Walton, who was educated at Polesworth Central School, started his business career with the Pooley Hall Colliery, Ltd., in 1911, and became accountant of the Electrical Supply Department of the company in 1923. He was appointed accountant of the Tamworth District Electric Supply Co., Ltd., on its formation in 1930, and acting local manager in 1945.

Mr F. Isherwood, a director of Yorkshire Switchgear and Engineering Co., Ltd., for about 30 years, died on 15 Oct., aged 74.

NEW LITERATURE

Electrical Who's Who

AGAIN enlarged with the addition of further names, this new edition (the third) once more provides a comprehensive guide to the leading members of the professional and industrial branches of the Electrical Industry. As before, the names are placed in alphabetical order, in most cases an abbreviated biography being included, and all the information has been brought up to date. A new feature, which should prove valuable, is an index in which the entries are classified under the names of the companies, boards, Government Departments, etc. Claiming that practically everybody of importance in the electrical world is to be found between its strong covers, the *Electrical Who's Who* has already proved itself an indispensable volume on the reference shelf. Even at its increased price of 21s., it is a "must" for the library. Distributed by Iliffe and Sons. 354 pages, 8¾ in. by 6 in.

Electrical Contractors Year Book

IN this 1954-55 edition the list of names and addresses in the Membership Section, given in geographical order in the previous edition, have now reverted to the traditional order of the branches. To assist readers, however, there is included a list of place names with a cross reference to the branches concerned, from which firms in a particular area can be selected without much difficulty. Otherwise the volume conforms to practice of previous years, with a fairly lengthy exposition on the law for electrical contractors, the 1937 Electricity Supply Regulations, and full details of the wages agreements and working conditions applying in the contracting industry. An addition is a short list of other special regulations. Strongly bound, to withstand frequent use, this volume provides up-to-date information of value to all concerned in the contracting industry. Published by the Electrical Contractors Association. 761 pages, 4⅛ in. by 7¼ in. price 20s.

Raw Materials for Electric Cables

by A. King and V. H. Wentworth, B.SC., A.R.I.C., A.R.AE.S., F.I.R.I.

WITH their background of the specialised and highly skilled industry of cable manufacture, the two authors (whose own fields are in power, rubber and plastic cables), with assistance covering other branches of the industry, have, in this book, provided clear and forthright information of the sources of all materials used in their industry. Moreover, the details given of the chemical, physical and mechanical properties of each material claims for this work a place on the bookshelf of all persons involved with cables, whether from the manufacturing, or utilising side.

As copper is the conventional material for conductors of power and telephone cables, the book logically opens by considering this material, giving most attention to these applications, which accounts for the greatest proportion of copper used in the cable industry. The subject matter then turns to insulating materials, discussing the full range from paper, insulating oils and compounds, to the various types of plastic sheath. Lead and aluminium are then introduced, followed by a useful consideration of armouring, and the properties, manufacture and use of steel. Further types of insulant—textiles, wax impregnants, lacquers and special types receive due treatment, with a closing chapter discussing control of cable quality. Published by Benn, 362 pages, 8½ in. by 5¼ in. Price 42s.

BOOKS RECEIVED

Electrical Ignition Equipment, by F. G. Spreadbury. Discusses principles, construction, design and testing of ignition equipment for i.c. engines together with engine requirements and ignition conditions. Published by Constable, 227 pages, 8½ in. by 5½ in. Price 25s.

Laplace Transforms for Electrical Engineers, by B. J. Starkey. General introduction to a large subject, using a physical rather than purely mathematical vocabulary. Published for the "Wireless Engineer," by Iliffe and Sons. 279 pages, 8½ in. by 5½ in. Price 30s.

Electrical Engineer's Reference Book, edited by E. Molloy, M. G. Say and R. C. Walker. Considerable number of new sub-sections in this edition, including new material in the "Progress" section. Seventh edition, published by Newnes, 2,184 pages, 7¼ in. by 4¾ in. Price 70s.

Practical Television Circuits, by F. J. Camm. Constructional details with wiring diagrams of a number of tested and successful television receivers, suitable for amateur construction. Published by Newnes, 288 pp., 7¼ in. by 4¾ in. Price 15s.

A Concise History of Mathematics, by D. J. Struik. Follows mathematics from earliest records to beginning of present century, emphasising development of a few main ideas. Published by Bell and Sons, 299 pages, 7¼ in. by 4¾ in. Price 14s.

The Properties of Tin. Completely revised edition carried out by C. J. Faulkner for the Tin Research Institute, aiming at giving one recommended value for each property under stated conditions. Fourth Edition, published by the Tin Research Institute, Fraser Rd, Greenford, Middlesex, 55 pages, 9¾ in. by 6 in. Price 2s. 6d.

Fundamentals of Electrical Engineering in M.K.S. Units, by E. Hughes. Standard text book covering syllabuses of 3rd year O.N.C. course, 1st year for an engineering degree and C. and G. Inter. in "Electrical Engineering Practice," and using m.k.s. units throughout. Published by Longmans, Green and Co., 470 pages, 7¼ in. by 4¾ in. Price 12s. 6d.

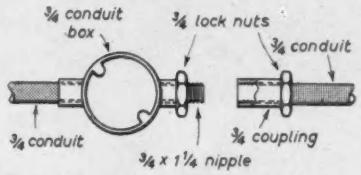
PROBLEMS AND PRACTICE

In Engineering

Every engineer has a story to tell; why not tell yours on this page? We welcome contributions to this feature, and those published will be paid for at our standard rates. Problems which are encountered and overcome in day-to-day maintenance or installation of electrical plant; useful methods and techniques developed for specific jobs, or current practices, all make instructive reading for others. We will also consider for publication problems requiring an answer. Sketches are often helpful and need only be rough, as they will be redrawn before use.

Running Joints

THE method showing the use of a conduit box to eliminate running joints, found by W. Satchwill whilst rewiring an old installation (Sept. 23 issue) must have been used in the early days of conduit running. The idea is a bad one and I hope none of your readers tries it. Apart from the waste of using an oversize fitting and two reducers, the amount of thread left in the reducers after they are pulled up would not be sufficient to make it mechanically safe or



Suggested method of making a running joint at a conduit box

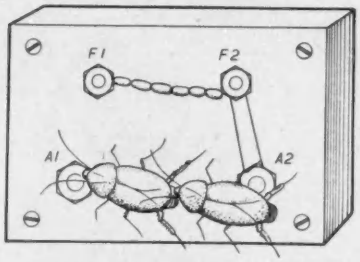
good continuity, even if lock nuts are used. Moreover the sharp threads inside the reducers would most likely damage the cable as the conduit, when using reducers, should always be threaded long enough to cover the inside threads. The best way of making a running joint at a conduit box is by screwing the box on to the conduit one end and fitting a nipple in the other end, which is secured with a lock-nut, as shown. It is then only necessary to connect an ordinary runner to the nipple.—*R. W. Marrison.*

Bugs on the Board

OWING to severe weather, I was forced to remain for a couple of days in a large town in the interior of Brazil, staying at a hotel whose proprietor, as a result of previous visits, was well known to me. Not only one of the big political mandates of the town, this gentleman was also owner of a large daily newspaper which renders him a considerable revenue. As the paper's staff have to work practically all night, he had installed his own power station as the town's supply closed down shortly after midnight.

On this occasion, the proprietor approached me with the information that his press had been closed down for the last five days due to a generator fault, dropping the hint that he would like me to have a look at it. On the way down to the power station, he told me that four of the best electricians from the State's capital (whom he had called in specially) had unanimously declared that the generator's armature had burnt out.

On arriving, I observed the machine to be an ordinary d.c., shunt wound type, of German origin, rated at 170 kW, 110 V, 1,100 r.p.m. It had been partially dismounted, the brush holders and armature lying apart, the frame and field coils still in place. To all appearance the armature looked in order but I refrained from giving an opinion until I myself had examined it. Consequently, next day, armed with a radio test instrument, (the only instrument obtainable) and with the help of a 6 V battery, I carried out usual tests for earth and continuity, proving to my satisfaction that no short-circuits existed in or between the armature coils. Moreover, field coils, and switchboard connections were also in order so the machine was reassembled and run up to speed, but even with the field regulator at maximum no results were obtained. Finally, after rocking the



Fortunately only a rare source of trouble—cockroaches nestling across armature terminals, and their eggs short-circuiting field terminals

brush assembly up and down, I was able to obtain a fluctuating voltmeter reading from 10 to 25 V and a feeble glimmer in the pilot lamp.

Undoubtedly, everything pointed to a faulty armature and I began to believe the electricians (two of whom were familiar to me), but long experience had taught me to remain firm in my convictions after a personal examination of this kind of electrical problem. As a last resort, some fully charged batteries were connected direct to the field coils, with the aim of drying out the armature in case it should have become damp due to the bad weather. After five hours running, with a considerable temperature rise in this part of the machine, no improvement was obtained.

After eliminating those tests already carried out, I was left with two items yet outstanding—the insulation between brush and brush holder, and the machine's output terminal board. As the brushes were in order, I removed the terminal board, the ordinary 6 in. by 4 in. by ½ in. bakelite slab.

On its removal two enormous cockroaches were found, still alive, and comfortably nestled across the main generator's terminals, whilst a neatly laid layer of eggs spanned the board between the two field terminals. These cockroaches, incidentally, are not the ordinary household kind, being considerably larger—up to 3 or 4 in. long—and are frequently found and bred on the Brazilian palm-tree. Although sluggish in their movements, they are very ferocious and their bite is venomous. Knowing the disastrous effect of the acidic mucous they leave along their trail, I at once attributed the fault to their presence.

On examination (after carefully removing the cockroaches with pliers and leaving the eggs in position) the board was found to be covered with mucous, whilst a test showed the resistance between the main terminals to be only 200 ohms, and the field terminals to be effectively short-circuited by the eggs. These abnormal conditions were clearly the reason for the generator failing to build up voltage, and when, after thorough cleaning, the terminal board was replaced, the machine generated immediately without further trouble.—*E. Gatis.*

Creep of Ball Races

WHEN creep of ball bearing races is encountered it should be realised that this trouble does not arise from friction in the bearing itself. There was a school of thought which held the opinion that slow creep of the outer race would eliminate continuous stress on a particular section of the outer race thus equalising the wear but this is not proved in practice. Creep will cause wear of the bearings and housing and where high pressures and minute movement are encountered "fretting corrosion" results, the product of which (iron oxide) if gaining entry to the bearing will effectively shorten its life.

Generally unbalance of the rotating member will tend to cause creep in a stationary journal race and intermittent loading will also produce this tendency. The effect of out of balance is that the point of maximum load circulates round the stationary race tending to drag it round in its housing. Creep is never desirable and care must be taken to ensure correct dynamic balance of the rotating member and the mounting of the bearing must be square and in accordance with the makers' recommendations regarding fits.—*"Torque."*

Equipment for Industry

Busbar Trunking

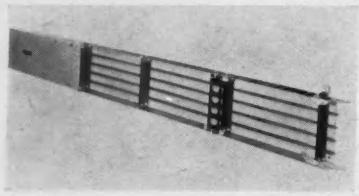
THE modern method of transmitting power round a factory or other industrial installation is by using busbar trunking. Simple to install and requiring no maintenance its popularity is on the increase. A new metalclad distribution system produced by GENERAL ELECTRIC Co., LTD., Magnet House, Kingsway, has busbar capacities ranging from 75 to 200 A and is said to have retained all the installation advantages of the heavy pattern trunking.

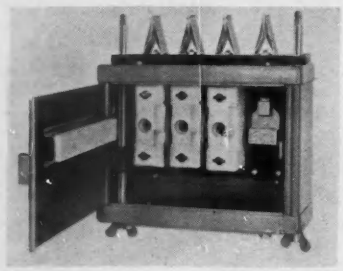
Conductors for the system, either 2, 3 or 4, are of hard drawn copper bars in sections and ¼ in. x ¼ in. for 75/100 A and ⅜ in. by 3/16 in. for 150/200 A. To allow for expansion or contraction under varying temperatures, special joints are incorporated, these are placed at 12 ft intervals along the trunking. Supporting points 3 ft apart are provided within the trunking by Bakelite insulators. Where fused tap-off outlets are required at 2 ft centres, additional supports are provided.

The trunking is made in 12 ft sections and measures 9½ in. by 2½ in., the mild steel casing being of 16 s.w.g. Terminal stop ends, conduit or cable and universal entry units may be supplied in addition to horizontal and vertical right angle bends, tee and intersection units. These are all similar in section to the trunking.

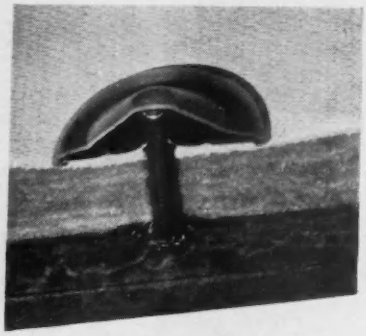
Tap-off units, one is illustrated below, are capable of handling up to either 30 or 60 A. Supporting members, ¼ in. diameter rustless steel, are fitted with wing nuts and washers and each unit has robust contact fingers. Members are arranged to prevent accidental reversing of phase sequence and form part of the tap-off unit, since they are threaded at the upper end for screwing internally tapped sections within the trunking. This permits the tap-off unit to be secured to the system from the underside.

Contact fingers are of two kinds, the one has heavy copper contacts reinforced by steel springs, and the other contacts of a specially designed extrusion. Mouldings fitted within the unit, shroud the contact stems and are designed to permit removal of unwanted contact fingers and strapping of stems as required. Each tap-off unit contains fuses and link for d.p., s.p., and n.t.p. or t.p. and n. systems as required. Horizontal tap-off units may be supplied, in which case the hinged door opens downwards.





Tap-off units are available in either 30 or 60 A rating for this new busbar trunking seen above



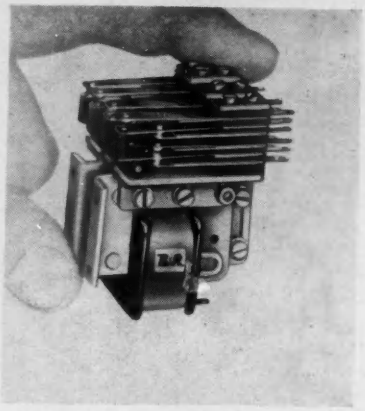
This novel method of securing insulation has great possibilities

Fixing Insulating Sheets

A NEW technique employed by the Admiralty, for fixing insulation to metal surfaces is now available and is suitable for use in applications where it is necessary to attach thermal or acoustic insulation. For some time now warships have had deck and bulkhead insulation, the material used for this purpose being a fibreglass sheeting known as "Navyboard." The procedure adopted for securing this sheeting was developed by the stud-welding division of CROMPTON PARKINSON LTD., Crompton House, Aldwych, W.C.2. The technique consists of initially stud-welding 3/16 in. diameter pins (these have flat, slightly chamfered ends) to the platework. Insulation is then impaled on the pins and secured by polythene-capped "Speed Fixes." These are perforated spring steel washers having two teeth. When pressed over the pin, which may be steel or aluminium, the teeth grip it tightly. Advantages claimed for this system are simplicity, speed and low cost in addition to the consideration that the surface is not perforated and this precludes formation of weak spots susceptible to corrosion and mechanical stresses.

Miniature Relay

SPECIALLY designed to meet the requirements of the aircraft industry and for use in electronic equipment and industrial control systems a new miniature relay, the type "J.O1," is robust yet small and light. Many features normally included in large equipment have been embodied and these include laminated armature and frame, "Oilite" bearings and buffered contacts. Coils are wound for operation on up to 250 V and contact sets can be arranged to make (n/o) break (n/c) or changeover. Close stacking is facilitated by the low heat dissipation claimed for these relays. Soldering tags are all at one end. Coil burden is normally 2-5 VA. The relays are manufactured by BESSON AND ROBINSON LTD., 6 Government Bldgs, Kidbrooke Park Rd, S.E.3.



Light in weight these relays are suitable for use in aircraft

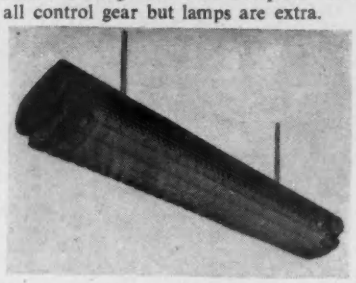
Aluminium Cable ratings

GREAT advances have been made in recent years in the use of aluminium in cable technology, not only for conductors but for sheaths also. Earlier this year we published tables showing the rating and size of such cables and now this information has been published, in the convenient form of a booklet, by the CABLE MANUFACTURERS ASSOCIATION, 52/54 High Holborn, W.C.1. This publication entitled "Current ratings for aluminium cables" gives full information on all types of cables manufactured, including those for use on a.c. and d.c. systems and S.L. cables.

Two further publications issued concurrently, are "Plastic cables and flexible cords" and "Paper insulated power cables." These cover the history of the development, and manufacturing techniques of the respective types and are of more general interest. All three booklets are obtainable on application to C.M.A.

Scemco's "Cascade" is New

NOW in great demand is the new "Cascade" fitting introduced by SCEMCO LTD., 6 Soho St, W.1. It is a twin lamp fitting with all-plastic diffuser made in various sizes. Size 5 ft twin costs £15. 15s. plus £1. 5s. 4d. p. tax; 4 ft twin costs £14. 14s. plus £1. 2s. 6d. p. tax; 2 ft twin 40 W £10. 17s. 6d. plus 13s. 2d. p. tax and 2 ft twin 20 W £10. 10s. plus 13s. 2d. p. tax. Colours amber and pink 10% extra. Fittings are sold complete with all control gear but lamps are extra.



Plastic cell diffuser is a feature of the Cascade

Britannic Flexible Again

ANNOUNCEMENT by BRITANNIC ELECTRIC CABLE AND CONSTRUCTION CO., LTD., says that they are again able to make prompt deliveries of flexible rubber-insulated trailing cables, to meet the requirements of collieries, quarry excavators, mobile crane operators, and also for electric welding circuits.

Completely homogenous, compound rubber-insulated and sheathed steelwire-armoured power cables, specially designed to meet the arduous conditions encountered in mine shafts and underground workings, can now also be supplied at short notice in a wide range of conductor sizes. The firm's address is Iver, Bucks.

"Hy-Ray" for Window Lighting

NEW semi-recessed window lighting fitting for use with either 100 or 150 W b.c. pearl lamp is one of a new range introduced by COURTNEY POPE (ELECTRICAL) LTD., Amhurst Park Works, Tottenham, N.15. This D.112 "Hy-Ray" fitting is fabricated from super pure anodised aluminium. It is adjustable, pattern

Hy-Ray is one of a new range by Courtney Pope

pierced for decoration and has an annular slot for ventilation. It requires a 7½ in. diameter cut out for fixing and is supplied complete with soffit ring, fixing screws, and holder at £2. 15s. A louvre is 10s. 6d. extra.

Courtney Pope say that they have produced a complete range of fittings, some smaller and some for surface mounting, amongst which the architect will find what he wants without the need for special production.

Frigidaire Price Drop

SUBSTANTIAL reduction in the price of the 4½ cu ft "Family" model refrigerator down to 66 guineas inc. p. tax is announced by FRIGIDAIRE DIVISION OF GENERAL MOTORS LTD., Stag Lane, Kingsbury, N.W.9.

This is the third reduction in price of this model which started life eighteen months ago costing £99. 19s. Despite constant improvement it has been found possible to reduce the price three times as sales volumes have increased thus resulting in lower production and distribution costs.

Desk Model Klamplight

RANGE of Klamplights by BATTENBERG AND CO., LTD., 7 and 8 Great Winchester St, E.C.2, has now been augmented by a desk model. Fully adjustable this new model stands firmly on its weighted base. In common with all other Klamplights this new model is hand-made from seasoned beech and wax

This desk model is first of many new models

polished by hand for a perfect finish. The shade is spun aluminium stove enamelled in seven attractive *House and Garden* colours. Retail price is 29s. 9d. complete.

—and more new types to follow

In addition the company is introducing later this year a new range of household and industrial reflector shades in various shapes and sizes and finished in the usual glossy enamel. Prices will range from 5s. 3d. inc. tax. An industrial spotlight, bullet-shaped with an adjustable swivel designed for window and display illumination, will be introduced in a variety of colours, price 35s. less trade discount.

For the Electrical Trade

"Mitey" Midget Hairdryer

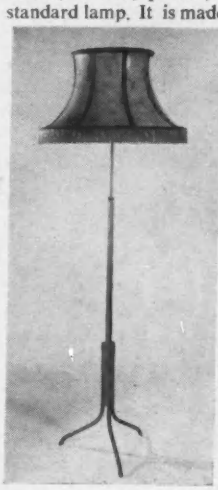
ONLY 5½ in. overall and weighing under one pound the "Mitey" hairdryer by BESTFREND ELECTRICAL CO., LTD., Diceland Works, Banstead, Surrey, certainly seems at 45s. plus 8s. 3d. purchase tax to justify the makers' claim that it is the smallest, lightest and cheapest hairdryer on the market.

Made in two models, lustrous walnut and porcelain ivory (47s. 6d. plus 8s. 8d. purchase tax) the "Mitey" is controlled by push button switches.

For use on a.c./d.c. 200/250 V (or 100/130 V the "Mitey," fitted with TV interference suppressor is supplied complete with zipped pigskin leatherette wallet.

Floor Fitting by Froy

NOW marked by FROYLECTRIC LTD., Leamore St, W.6, wholesaler side of W. N. Froy Ltd. (see ELECTRICAL TIMES, 7 Oct., p. 532) is an adjustable standard lamp. It is made of anodised aluminium in red, green or blue with the adjusting unit and rings chromium plated. The centre shaft is telescopic and can be fixed at any height from 4ft 6in. to 6ft 6 in. from the floor. Retail price is £6. 1s. 11d. (excluding shade). Great advantage of the fitting apart from adjustability is its light weight and good stability.



Miniature Motor for Modelmakers

NEW style, redesigned and improved, the Ever Ready 6 V miniature model motor is now available. This little motor —it weighs only 1·4 oz and measures 1 in. dia x 1 3/32 in. long excluding spindle projecting 19/64 in. each end—has been designed by the EVER READY CO. (GREAT BRITAIN) LTD., Hercules Place, N.7, to operate primarily from a 6 V dry battery. B.h.p. of the motor at maximum efficiency is ·001 at 6,000 r.p.m. Current drain at speeds between 4,000 and 9,000 r.p.m. under load varies between ·25 and ·8 amps.

Just the job for the miniature modeller

Available with or without black cellulose mounting the motor is enclosed in a cream cellulose acetate casing. It has bronze self-lubricating bearings and has contacts wired with p.v.c. leads. Price is 9s. 11d.

The "Adamaid" Washes Dishes

LATEST "Ada" washer is a three action automatic machine handling dishes.

Made by ADA (HALIFAX) LTD., Johnson St. Halifax, a firm with a reputation for quality the "Adamaid" is a neat efficient machine which washes, rinses and dries dishes in an automatic operation. The machinery is housed in a durable cream or white enamel cabinet, rust-proof throughout and measuring 36 in. high by 22 in. square.

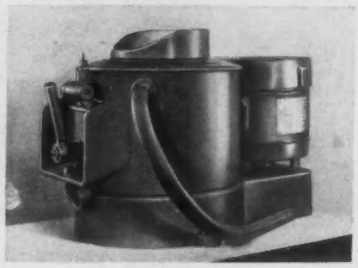
A most desired "domestic"

Designed to handle even the most fragile glass and crockery safely in the "easi-lift" containers with a "Roto-swirl" action, the "Adamaid" completes the whole action in three minutes. Maintenance and operating costs are negligible. Guaranteed for 5 years the "Adamaid" costs £49. 10s. plus £19. 6s. tax.

"Ali solder" for Aluminium Jointing

TESTS carried out on "Ali Solder" now distributed by AGRON LTD., 14-18 Queen Victoria St, E.C.4, have proved to their satisfaction that this new aluminium solder is easy to use, is free running, has excellent cohesion qualities and good resistance to corrosion and salt sea water.

At present "Ali solder" is only obtainable in stick form, each being approximately ¼ in. dia. and weighing 2 oz, the price being 26s. per lb. The ease and economy of use by unskilled labour is emphasised by the distributors.



7-8 lb per charge from the Easipeel

Power Peeling Potatoes

HANDLING 7-8 lb potatoes or other root vegetables per charge the Easipeel portable electric potato peeler by LABOUR SAVING APPLIANCES LTD., 5 and 7 Chester St, Manchester 1, retails at £28.

Peeling is by normal carborundum plate and sides powered through belt drive by a Hoover squirrel cage induction motor. Bearings are of the oil retaining phosphor bronze type. The machine is strongly constructed of cast aluminium and weighs 38 lb. It is especially suitable for small hotels, cafes and other caterers.

Choose Chalfont for Quality

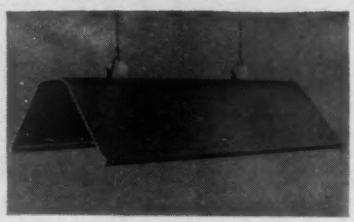
TWO recent additions to the domestic appliance range of CHALFONT ELECTRICAL PRODUCTS LTD., Tyrell St, Leicester, are the "Streamline" automatic electric kettle and the "Popular" washboiler.

The former is a robust 4 pint mirror finish aluminium kettle selling at 54s. It is designed for hard work yet has good appearance. Selling features are the comfortable one-piece plastic handle, a large lid, for easy filling, with generous steam vents. It is a full-sized kettle loaded 1,500 W yet we understand it will boil as little as one pint in just over 2 minutes. A thermal cutout safety device is fitted.

The "Popular" washboiler is an all-steel galvanised pan with lid and fitted with robust rapid-heating element. Its price is 67s. 6d. retail and distribution is through normal trade channels.

Philips Wooden Farrowing Unit

EXTRA low initial cost and efficiency were the two factors required by breeders which led PHILIPS ELECTRICAL LTD., Century House, Shaftesbury Ave, W.C.2, to design their new DUW/250 unit.



The DUW/250 is a low-cost unit

It is constructed of substantial flameproofed plywood painted in blue, flameproof paint with the edges reinforced. Two standard ceramic holders are used and as the unit is completely insulated there is said to be no special earthing precautions required. Two 250 W Infra Red heaters are used (18s. 5d. each) and complete with holders and two E/44 heaters, the unit sells at 67s. 6d. (no tax).

TRADE PUBLICATIONS

WASHING MACHINES.—New section for the English Electric Demonstrators Bulletin is that dealing with the 10-gallon capacity washing machines produced by the company.

CONSTRUCTION UNITS.—Trisec cold rolled triangular section, a new rapid construction medium, is described in a booklet issued by Imex Engineering Ltd., 257 Eglington St, Glasgow, C.5.

RADIO EQUIPMENT.—New electronic and radio equipment literature issued by The Plessey Co., Ltd., Ilford, Essex. Includes "Type PR 51C fixed station H.F. Fixed Frequency Receiver" Types RR53A and PR 53C for diversity working. Frequency shift keying equipment for radio teletypewriter applications and a brochure listing new Radio and TV components.

SWITCHGEAR.—Bill Switchgear Ltd., Aston Lane, Perry Bar, Birmingham 20, are now distributing a new price list PL 1054 which gives up to date prices for their switch and distribution gear and electrical accessories.

PUMPS.—The Vacseal pump is fully described in a new brochure issued by International Combustion Products Ltd., 19 Woburn Place, W.C.1. It is particularly suitable for the handling of liquid containing solids of an abrasive nature.

CEMENTS.—A new leaflet describing Sankey's Super Acid resisting cement is available from J. H. Sankey and Son, Ltd., Refractories Works, Ilford, Essex.

NEWS OF THE WEEK

Plans for Rail Electrification

BRITISH TRANSPORT COMMISSION REVIEWS SCHEMES FOR FUTURE

FUTURE schemes for railway electrification are given prominence in the sixth annual report of the British Transport Commission, published last week and covering the calendar year 1953. Amongst schemes out of London involved is that for suburban lines running from King's Cross. Recent work on track widening at Potters Bar is considered to make possible the increased train service that would follow electrification, and it is suggested that in any plans for further London electrification, high priority must be given to this route. Another scheme further developed during the year was that for an extension of the present electrified line between Liverpool Street and Shenfield to extend to Chelmsford and Southend. The line from Fenchurch Street to Southend is to be electrified later. Estimates of cost are being made for the completion of Southern Railway electrification to eliminate steam traction east of the line Reading-Portsmouth, and some consideration has also been given to a 71 route-mile electrification scheme for Glasgow.

In the London Transport section of the report, the most interesting proposal discussed is that for a new tube railway running south-west to north-east across London. The Government has agreed that such a tube should be the subject of intensive planning, and a study of its cost and economic effects is being carried out. Total cost is put between £50 and 60 millions.

The report expounds at some length the Commission's policy in making a substantial investment in diesel multiple unit trains. It is claimed that these offer the benefits of electrification without the need for heavy capital expenditure on fixed equipment or substantial engineering works. "At a time when there are arrears of work to be undertaken in rehabilitating the railway system as a whole, this is an important factor." It is recognised that for the heaviest density of passenger traffic, electrification will probably always have an advantage.

There is no discussion in the report of main line electrification. It is noted, however, that during the year all four main-line diesel-electric locomotives were transferred to the Southern Region for comparative tests. The two gas turbine locomotives in the possession of the Commission were employed on main-line service in the Western Region.

London Consumers' Council discuss Three Problems

AMONG matters discussed at last week's meeting of the London Electricity Consultative Council were the identity of meter readers, discounts for prompt payment of electricity bills, and assisted wiring schemes. The problem of making the Board's meter readers easily recognisable by housewives has occupied this Council for some months now, and it was therefore with some pleasure that members learnt that the Board is proposing to put all their metermen into uniform. A final decision has not yet been taken. The suggestion that discounts should be allowed for prompt payment of bills has been rejected by the Board on the grounds that the disadvantages of such a scheme far outweighed the advantages. The Board's final decision on the suggestion concerning wiring maintenance schemes has been sent to the Metropolitan Boroughs' Standing Joint Committee. The proposal has been rejected, as anticipated in these columns some months ago. Responsibility for replacement of defective wiring should rest with the landlord or tenant, who should take advantage of financial and other facilities made available to them by statute, the Board maintains.

Open Days for Welders at End of November

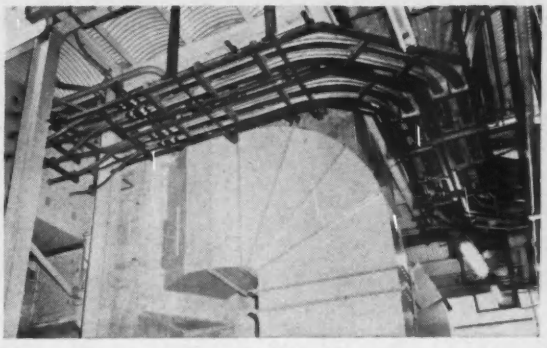
TUESDAY and Wednesday, 23 and 24 Nov. are the dates of the Open Days to be held by the Metallurgical Laboratories of the British Welding Research Association. Researches on ferrous and non-ferrous alloys will be displayed covering many welding processes including the argon-arc, metal arc and self-adjusting arc processes. Those wishing to attend should write to the Association's secretary at 29 Park Crescent, London, W.1. The exhibition will take place at that address and admission will be by ticket only.

Radio Engineers announce Premium Awards for Papers presented in 1953

PREMIUM awards for papers published during 1953 were announced by the Council of the British Institution of Radio Engineers last week. The premier award of the Clark Maxwell premium has been presented to the joint authors of "An Aerial Analogue Computor." The authors are Messrs W. Saraga, D. T. Hadley and F. Moss. Among the five other awards announced was the Sir J. C. Bose premium. This is the first time this prize has been given. It is intended for the most outstanding paper by an Indian scientist or engineer, and the winner is Mr S. K. Chatterjee for his "Microwave Cavity Resonators."

The Heinrich Hertz premium goes to Mr B. E. Kingdon of A.E.R.E., Harwell, for his paper on "A Circular Waveguide Magic-Tee and Its Applications to High-Power Microwave Transmissions," and the Louis Sterling premium to Mr D. A. Bell of Birmingham University for his "Economy of Bandwidth in TV." The Marconi premium goes to Mr Paul Eisler and the Dr Norman Partridge memorial award to Mr J. A. Youngmark. Their papers were on "Printed Circuits" and "Loudspeaker Baffles and Cabinets."

All these awards will be presented at the Institution's annual meeting in London next Wednesday. No awards have been made this year for the Brabazon, A. F. Bulgin and Leslie McMichael premiums, because papers of sufficiently high standard within the terms of the awards were not submitted.



Main generator cables, showing bonding and cable racking at Pretoria B power station in S Africa. The whole of the cabling for this station was carried out by Henley's (S.A.) Telegraph Works Co., Ltd., in Johannesburg. Consulting engineers were Merz and McLellan of Newcastle-on-Tyne.

Uruguay wants Capital Goods for Development

ONE of the most important markets overseas for manufacturers of electrical plant and machinery is the smallest of the S. American republics, Uruguay, often known as the Switzerland of S. America because of its stable and democratic government, not in keeping with the popular impression of those States. Business opportunities are plentiful, and this is borne out by the Economic Survey of Uruguay published last week.

It must be said at the outset however, that opportunities in the domestic market are most limited, mainly because Uruguay's own industry is quite capable of coping with the demand, and is protected by import restrictions. This particularly applies to such items as refrigerators, lamps, fittings and washing machines. A market does exist still for vacuum cleaners, polishers, radiators and drying machines.

As regards capital equipment, the picture is quite different. The State Electricity Board and Telephone Service (U.T.E.) has been carrying out a considerable development programme calling particularly for transformers and transmission lines. During 1951, imports of transformers, condensers, rectifiers, etc., valued $995,000 of which the U.S. supplied $417,000 and the U.K. $293,000. The market for electric cable is substantial and the U.K. is well to the fore among suppliers. The main source of electric energy is the Rincon del Bonete hydro-electric station, situated on the Rio Negro. In passing it should be noted that work on that station was initiated by a German firm and completed during the war by a U.S. company. Total installed capacity is 128,000 kW. A further hydro-electric station lower down the Rio Negro is now planned at Rincon de Bay-gorria, thereby providing a further generating capacity of 103,000 kW. A $33 m loan was received from the International Bank in 1951 for extensions to the Montevideo thermal power plant, for development of the grid and modernisation of the telephone system. Montevideo's power station began with 90,000 kW capacity and in 1951 a further 50,000 kW capacity was added. Another 50,000 kW increase is planned. Several power grids cover parts of the country and new transmission lines are being built.

Finally, some criticisms of British export methods might well be noted. It is said that some sections of British industry are still trying to sell unsuitable goods to unwilling customers. Sales technique and technical service can be improved, and the use of Spanish and the metric system in trade literature will be far more beneficial. Designs must be more modern and adapted to Uruguayan tastes. Above everything else, however, there ought to be more personal visits to study the market and check agency arrangements.

OFFICIAL PUBLICATIONS

OVERSEAS ECONOMIC SURVEY. Uruguay, H.M.S.O. 3s. 6d. (see this page).

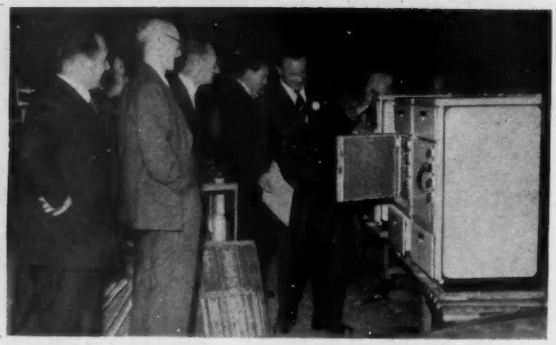
BUILDING. List of Government Publications, published by H.M.S.O.

BRITISH TRANSPORT COMMISSION. Annual Report, 3s. 6d.; Statement of Accounts and Statistics, 6s. 6d. H.M.S.O. (see page 605).

GAS COUNCIL. Fifth annual report and accounts for 1953-54. Also reports of the various Gas Boards and their Consultative Councils as well as that of the Minister of Fuel and Power. H.M.S.O. (see page 577).

Staff hear of Henley Progress

MORE than 700 members of the staff of the Henley group of companies gathered at the Dorchester Hotel, London, W.1, on Saturday for their annual dinner and dance. Presiding was Sir John Dalton, chairman of the group. In reply to the toast "The Henley Companies," proposed by Mr S. J. Wilson, he said that so far this year the companies had done more business than for the same period last year.



Some members of the catering trade during a tour of Simplex Electric Ltd's Blythe Bridge factory last week. In addition to about 18 representatives of the Catering Equipment Manufacturers Association's various manufacture members, the large party included representatives of catering associations and the Press

New Works at Hoddesdon

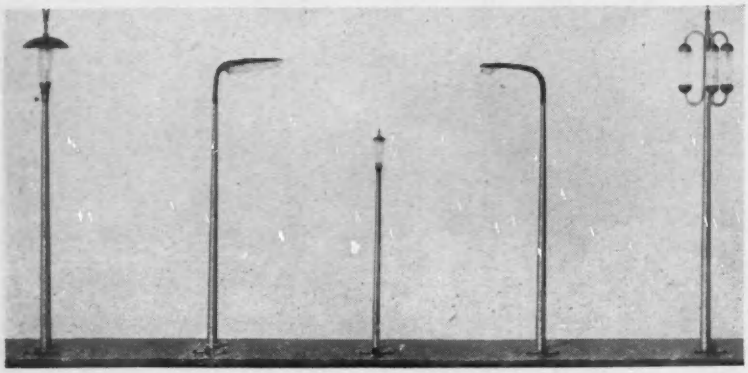
IN order to provide more efficient service and to provide, in addition, manufacturing, research and stock facilities, Claude Lyons Ltd. have acquired a new freehold factory at Ware Rd, Hoddesdon, Herts.

Special Street Lighting Units for Kuwait

STREET lighting for the rebuilt city of Kuwait is notable, not only because of the size of the contracts placed with British firms, but also because of the request to break away from conventional design whilst keeping units in keeping with local surroundings. A contract worth nearly £100,000 was awarded to Siemens Electric Lamps and Supplies Ltd. It involved all main roads and an additional 500 units for class B side roads.

The accompanying photograph illustrates the original models made by Siemens following extensive research and much trial and error at their workshops and laboratories. One development resulted in a new starter-switch for the fluorescent lamps, whilst the actual paint finishes experimented with led to a new heat, light and corrosion-proof finish which Siemens have named Haliglass. Actual production of the lighting units is now well in hand.

Lanterns for the wider roads will house three 5 ft 80 W daylight fluorescent tubes, and for the narrower roads two lamp lanterns will be used. Special attention is being paid to the tapering nature of the columns. Optical control is by aluminium reflectors incorporating a plastic bowl. Siemens equipment will be used extensively. Contracts in the same scheme have also been placed with other U.K. firms. Incidentally, besides their activities in Kuwait, Siemens are also engaged in schemes in other parts of the world.



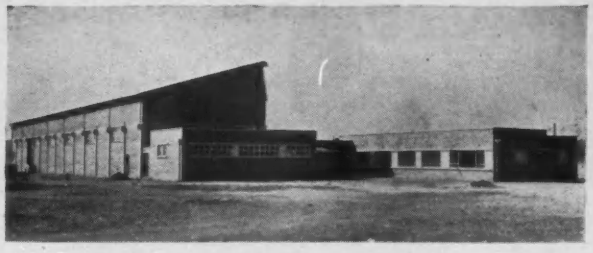
Models of Siemens' street lighting units for Kuwait installation

New British Factory in South Africa Starts Production

LAST week's news concerning S. African imports brought to mind the importance of that country as a market for electrical goods. An appropriate follow-up seems to be the information that a British manufacturer has established a new factory in the Union and is taking active steps to exploit the market. The company is the Wolverhampton manufacturers of switchgear, transformers, rectifiers and rotating electrical machines, Electric Construction Co., Ltd., and their new factory is situated at Duncanville, Vereeniging, in the Transvaal, near the Orange Free State border and about 35 miles from Johannesburg. The present buildings occupy about an acre but nearly seven acres have been purchased, so that plenty of room exists for future extensions.

The factory will produce equipment similar to that made at Wolverhampton, and it is noteworthy that the works will have its own sand-blast plant. Managing director of this S. African project is Mr S. M. Newsome, who has taken out with him key personnel from this country. Semi- and un-skilled labour is being recruited locally and the factory is already in production with a sizeable order book.

Vereeniging is a growing industrial centre on the Vaal river rapidly becoming famous for steel production and heavy engineering industries. It is on a coalfield and close at hand are the sizeable Klip and Vaal power stations.



General view of E.C.C.'s new works in S. Africa

Some early S. African manufactures leaving the Vereeniging factory.

AGREEMENT IN SHELLAC STANDARDS

LAC was the subject of a technical committee meeting of the International Standards Organisation held in London last week. The committee was organised in 1948, met for the first time in 1950, and had its second meeting in New York in 1952. At the opening session of the present meeting the chairman, Mr H. M. Patel (Secretary, Ministry of Food and Agriculture, Government of India) recalled that three draft specifications for seedlac, shellac and bleached lac had been under consideration for five years. There was no disagreement on the specifications for seedlac and shellac, and few difficulties on methods of test, except on the question of the iodine value of shellac. Mr Patel looked forward to the resolution of the few remaining difficulties. He went on to call for the adoption of agreed standards in trade practice without waiting for their finalisation. Ways and means of achieving this were included in the agenda of the meeting.

Mr Patel told the committee that the Indian Government had before it a proposal for introducing official certification for all lac exported from India. International standardisation would be of value in giving a basis for grading lac under such a scheme.

The meeting did in fact achieve agreement on the three draft standards mentioned, and these have now been forwarded to I.S.O. headquarters in Geneva for issue to member nations as a draft I.S.O. standard. If they are then approved, they will attain the status of I.S.O. standards with very wide recognition.

BRIGHTER DATES

WE ARE extremely grateful for two most refreshing calendars sent to us during the past week for the year to 30 Sept, 1955. One reached us from Metropolitan-Vickers Electrical Co., Ltd., and is adorned, as in previous years, with a lovely lady who should enhance office walls for 12 months (at least). A second was sent by Richard Klinger Ltd., who join the few who begin their calendar year in October. They have selected 12 excellent land and seascapes representative of the British Isles.

Cable Ship Completed

A SHIP'S maiden voyage is always an event. The *C.S. Recorder*, latest cable-ship to be added to Cable and Wireless Ltd's fleet is now ready to commence operation, and when visited last week was being loaded with cable for the first lap of its journey. From Porthcurno, near Land's End, the ship is following a route taking her over the trawler bank near the Scilly Isles to Gibraltar and, during this first leg, 200 miles of cable are to be laid to replace an existing cable.

Eventually the *Recorder* will be based on Singapore. Since she is the largest cable-ship of the fleet (3,300 tons) she is particularly suitable for work in the Pacific. Approximately 7,000 cu ft is available for stowing cable and complete testing facilities are available on the ship for location of faults and general cable-testing.

Aluminium for Cable

ALUMINIUM has in the past few years found greatly extended application as a cable material. Its availability in this field poses many problems for engineers, and information and data on the subject are welcome. The September number of "Development Bulletin" issue by the Aluminium Union Ltd, The Adelphi, John Adam St, London, W.C.2, is devoted to the presentation of such information. In successive chapters it deals with the basic properties of aluminium, with its application as a cable sheath, a conductor and as cable armouring. Finally there is a description of some miscellaneous uses found for the metal in electrical cabling and installation work.

The First Half-Century

On Tuesday last took place the first annual general meeting of what was formerly the National Electrical Contractors' Association. This body has been incorporated as a limited liability company, and the Board of Trade has authorised the elision of the word "Limited," the registered title being "Electrical Contractors' Association (Incorporated)." The members are naturally proud of their new dignity, and perhaps a little disposed to over-rate its importance. There is, however, a vast field of usefulness for a body that focuses the views and the influence of the installation contractors. Already about two hundred and fifty firms have joined, and a large accession of members is anticipated. — *From our issue of* 20 *October*, 1904.

Commercial Conferences

TWO one-day conferences were held recently at Hull and Ilkley by the Yorkshire Electricity Board for their commercial staff. They were attended by the chairman, deputy chairman, some part-time members, chief officers and sub-area managers of the Board, and by some 70 delegates in each case. The last were members of the commercial staff responsible for showrooms. Before the conference each person had to study the chairman's paper at last June's B.E.P.C. on "The Development of the Domestic Load at Home and Overseas." The conferences were divided into seven syndicates who spent the morning discussing the paper and its implications. In the afternoon each syndicate reported to the conference, the chairman dealt with points arising and there was further discussion. The conferences were said to be highly successful.

High Speed Reclosing

IN our issue of 7 Oct. we referred to Mr G. F. Peirson as having been a member of the B.E.A. Productivity Team which visited the United States in Nov. 1949. In fact, Mr R. Mallet, who at that time was Deputy Chief Engineer to the Midlands Board was selected as a member of the team. Mr Mallet feels that a particular debt of gratitude is owed to Mr Matthews of the Detroit-Edison Co., for providing necessary information on high-speed reclosing techniques to the members of the team. He also would like to point out that it may be of interest to record that an order for no less than 180 of the B.T.H. Company's reclosers has been placed for the Worcester and District Sub-Area alone. This shows the Midlands Board's faith in this type of equipment. In the system of live-line working at 11 kV, which we also described briefly in the article, we mentioned the special tools used. Mr Mallet thinks that credit in the design of these tools should be given to Mr J. P. Ferrer, Engineer of the Worcester and District Sub-Area.

The electricity stand organised by the E.D.A. at last week's Nursing Exhibition held at the Seymour Hall, London. All aspects of the part which electricity can play in the life of the nursing profession, whether in the hospital, in district nursing, or in the nurses' off-duty periods, were shown—a most comprehensive display which attracted much attention

E.A.W. ACTIVITIES

30th Birthday

THE E.A.W.'s 30th birthday occurs on 12 Nov. The Association was founded in the home of Sir Charles and Lady Parsons in 1924 at a meeting of representatives of the electrical and educational worlds. Under the leadership of the founder-director, Dame Caroline Haslett, the organisation has grown phenomenally. It has been decided that because of Dame Caroline's illness, the official birthday celebrations will form part of the 30th annual conference to be held next April. Dame Caroline is at present recovering in the country and hopes to resume work before the end of the year.

Teaching Housecraft

ANOTHER one-day conference for teachers on Electrical Housecraft, is being organised by the E.A.W. It will take place at the Domestic Science Training College, Knighton Fields, Leicester, on 20 Nov. and follows the most successful conferences held in the S. West, N. West, N. East and Yorkshire.

Electrical Education

A SPECIAL week-end conference was organised by the E.A.W. Scottish Council at the Northern Hotel, Aberdeen, last week. Subject of the conference was electrical education.

Special Cardiff Meeting

A SPECIAL open meeting is being arranged by the S. Wales branch of A.S.E.E. It will take place at the Angel Hotel, Cardiff, on 2 Nov. The paper is entitled "The Design of Electrical Installations in Public Buildings—particularly in Schools" by Mr R. C. Woodward.

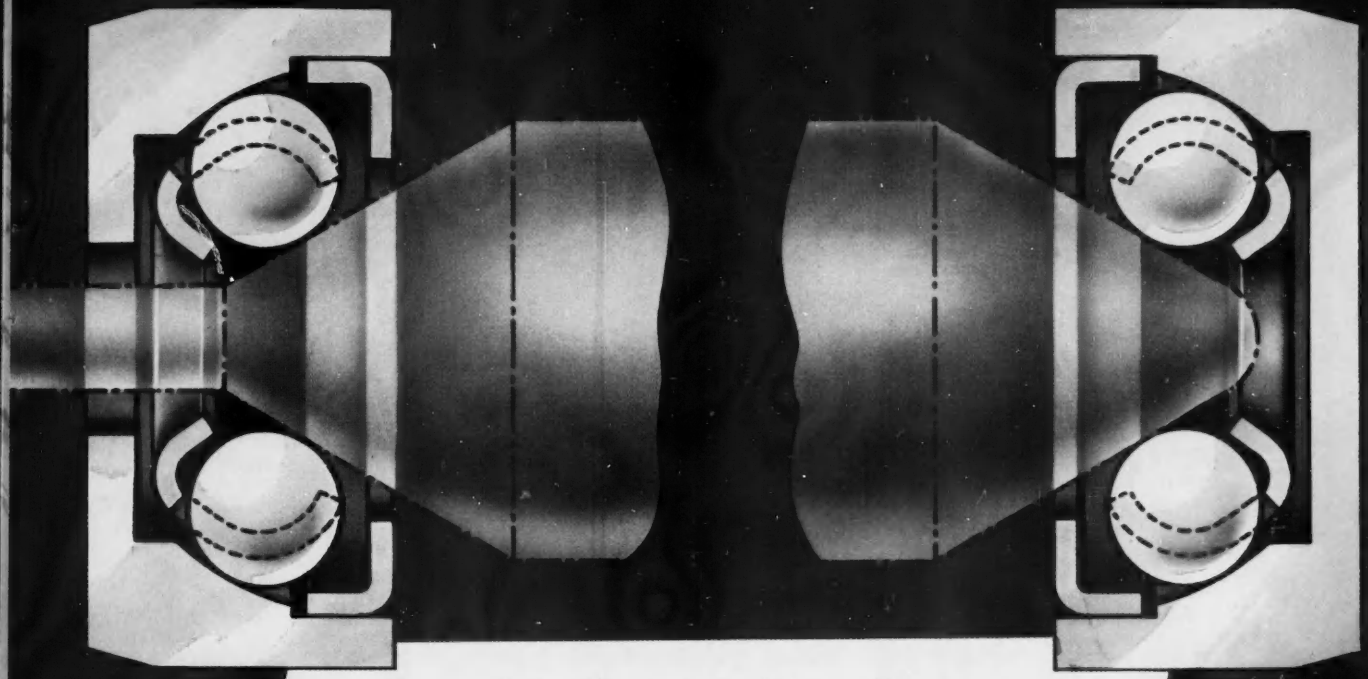
Latest addition to the transport fleet of Dimplex Ltd. is this 5-ton Dodge fitted with a Perkins Diesel. Special feature is the Luton bodywork which has an electrically operated sliding roof, and an inset above the driving cab in which is placed one of the company's radiators. The latter can be illuminated. Bodywork is by Sparshott

Scottish Wholesalers entertain E.W.F. Council

THE hospitality of the Scottish section of the Electrical Wholesalers Federation is impossible to ignore, and once again the Council of the Federation accepted the section's invitation this year to hold a meeting in Scotland. This time the scope of the function was extended and invitations sent also to the Councils of E.L.M.A., the Rubber and Thermoplastic Cable Manufacturers' Association, and to officers of the E.C.A., the E.C.A. of Scotland, the Assoc. of Manufacturers of Small Switch and Fuse Gear, and the Assoc. of Manufacturers of Electric Wiring Accessories. Unfortunately the A.M.E.W.A. and E.C.A. were unable to be represented.

The meeting took place at the Turnberry Hotel in Ayrshire. Apart from the business sessions there were golf competitions and the annual dinner. As in previous years, the function was highly successful.

40 TIMES FULL SIZE



Register that trickle of current

Meters with bearings having appreciable static friction can miss a lot of revenue.

F.B.C. miniature ball bearings are now at the disposal of meter manufacturers in a range of sizes: they have extremely low starting and running friction.

The section above shows, enlarged 40 times, a bearing 2·5 mm. O.D. The simple straight tapers for the inner contact can be easily ground by the meter manufacturer on his own spindles, which can thus incorporate individual features needed in the instrument. The outer race has a spherical self-aligning track, so that some degree of error in the frame of the instrument is accommodated.

The sizes range from 1·5 mm. O.D. to 10 mm. O.D., and the open cup (see left above) will clear spindle extensions ranging from 0·25 to 2 mm. according to the size of bearing.

Fuller particulars and sizes are available on application.

SOME BEARINGS, ACTUAL SIZE

FISCHER BEARINGS COMPANY LIMITED, WOLVERHAMPTON

Fischer Bearings Company Ltd., and Timken-Fischer Stockists Ltd., Birmingham, are both subsidiaries of British Timken Ltd.

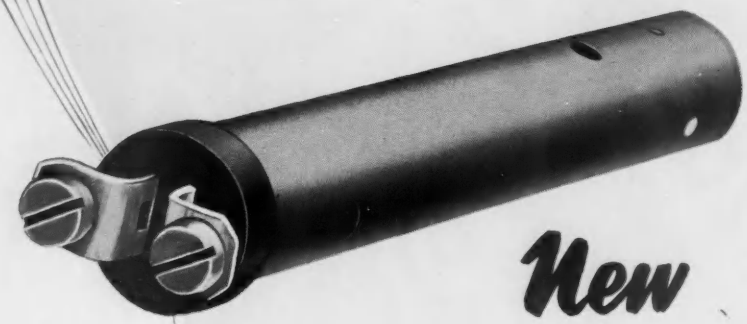
FBC TRADE MARK

ALL-BRITISH

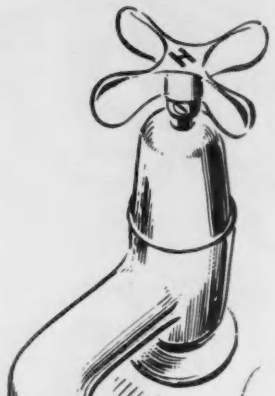
F.B.C. :: FISCHER

BALL AND PARALLEL-ROLLER BEARINGS

PROGRESS IN CONTROL



New



WATER HEATER THERMOSTAT

at half the price!

For many years the name Sunvic has meant dependable thermostatic control of electric water heaters. Now a new model, type TQB, whilst maintaining the same standard, is at the same time more compact and costs half the price. It is an immersed, withdrawable type and its performance complies with BS. 1555.

The only available thermostat conforming to present trends, its introduction marks an important advance in thermostat design.

One more example of the continuous development of *CONTROL*

EQUIPMENT BY SUNVIC

SUNVIC CONTROLS LTD. (*Domestic Division*), No. 1 Factory, Eastern Industrial Estate, HARLOW, ESSEX. *Tel.: Harlow 24231/5.*

Manufacturers of the Simmerstat, Oven Thermostats, Radiant Hotplates and Pneumatic and Electrical Instruments for detection, measurement, control and recording of Temperature, Flow, Liquid Level, Specific Gravity, and Pressure, in Science and Industry. Vacuum Pumping and Measuring Equipment, etc.

Member of the A.E.I. Group of Companies. TAS/Sc.D.282

How you can obtain Income Tax Relief

WAYS in which the Treasury will help to pay for the modernisation of trade equipment and industrial plant are outlined in a folder entitled "Income Tax Relief and How You Can Benefit," published by the E.D.A. The leaflet draws attention to the investment allowances made available by the Finance Act, 1954, which was intended to encourage the modernisation and re-equipment of industry and agriculture. Suggestions for plant and appliances eligible for relief under the Act on the farm, in the factory, the workshop, and in the catering trade are given. Copies of the leaflet may be obtained either from the association or from local Electricity Boards.

NEWS IN BRIEF

At a meeting of the Corporation of Industrial Managers on 10 Nov., Mr Winston Rodger of D.S.I.R. will speak on "The Manager and Industrial Engineering." The meeting will be at the Charing Cross Hotel, London, W.C.2, at 7.30 p.m.

Second edition of the BEAMA Catalogue is among the volumes chosen for the current exhibition of "100 Good Catalogues" at the British Institute of Management, 8 Hill St, London W.1.

London Regional Conference of the Institute of Cost and Works Accountants took place last Saturday.

Private Wire is the title of a new house organ published by the British Driver-Harris Co., Ltd. for their customers and associates. The first issue appeared last month.

Sayings OF THE WEEK

"I would claim that the women of England are the cleanest and thriftiest in the world, yet they spend money to create smoke and dirt to such an extent that it seems to have become a national pastime." . . . MR L. JOYNSON-HICKS, Parliamentary Secretary to the Ministry of Fuel and Power, speaking at the British Coal Utilisation Research Association luncheon.

"It is just not true that German scientific instruments are better than British." . . . MR A. J. PHILPOT, director of the British Scientific Instrument Industry Association, at its convention at Eastbourne last Thursday.

"Every time the Buy-American Act is enforced to favour the purchase of some higher-costing American equipment over a lower foreign bid it causes only a small ripple of interest on this (U.S.) side, but it creates waves of headlines and criticism, resentment, and bitterness in the country affected overseas." . . . MR WINTHROP ALDRICH, U.S. Ambassador to Britain, speaking in New York.

ELECTRIC SUPPLY NEWS

Eire

The new Marina power station, Cork, of the Electricity Supply Board, is rapidly nearing completion, and is expected to be on load very shortly. Two 30 MW steam turbo-alternators, of German manufacture, have been installed. The boilers are to be coal-fired but provision is made for oil-firing if required. Ash is to be sluiced to a piece of adjoining waste land. Cooling water is drawn from the River Lee. Present plans provide for an extension of the station to 120 MW capacity if necessary, but as the Board has several other turf-fired and hydro-electric stations under construction, it is unlikely that further expansion will take place at the Cork site for some years.

Fife

The views of the people of Kincardine-on-Forth regarding the B.E.A.'s proposal to erect a large generating station outside the village were placed before the Fife Planning Committee in Cupar recently by Mr C. N. R. Ross, County Councillor for the area. Mr Ross said the station, which would cover 150 acres, would be the largest of its kind in Europe. It would have two 400-ft chimneys. Half the population averred that the station would mean a considerable loss of amenity. He asked the committee to consider the matter very carefully before giving approval to the project. Mr R. L. West, Newport, said he did not think there was the slightest hope that the committee could alter or affect the building of the station. But they could try to the best of their ability, to safeguard the community and amenities. It was agreed that a sub-committee discuss the matter and report.

Glasgow

The possibility of utilising a portion of the power generated at the Corporation's Pinkston power station for other consumers in Glasgow, was ventilated at the meeting of the South West Scotland Electricity Consultative Council recently. Pinkston is operated by Glasgow Corporation for power production for transport purposes and has been modernised and extended as a result of work now nearing completion. Mr J. S. Pickles, chairman of the Board, indicated that an arrangement might be effected soon to use such spare plant as existed. The Electricity Authority had been in touch with the Corporation on this matter; the two systems had been linked since the war and this made such an arrangement practicable.

The extensions to the Pinkston power station are to be officially inaugurated early in December, and Mr Thomas Johnston has been invited to perform the ceremony, we understand.

Isle of Man

Operations of the Isle of Man Electricity Board for the year ended 31 Mar. last, resulted in a profit of £52,254 on a turnover of £168,584. A further 258 consumers were connected, bringing that total to 9,705. In all, over 16,619,000 units were sold at an average price of 2·242d. p.u. The annual report states that more than 800 of the 1,145 farms and smallholdings in the island have now a supply of electricity. This work has been financed partly by grants made by Tynwald and partly from the Board's own resources. During the year the Board's system was extended by 2 miles of o.h. h.t. and 9 miles of o.h. l.t. lines, a further 4¼ miles of l.t. underground cable was laid. No provision has been made in the accounts for a claim of £150,000 which, it is stated, has been submitted to the Board by the Douglas Corporation.

Torrington

The Rural Council has been assured that money was no longer the limiting factor in rural electrification. It had been suggested that, in view of the delay in getting rural electricity, the Council should ask the Government for a bigger Exchequer grant through the Rural Councils' Association. But Mr R. Robinson, district manager at Barnstaple, for the South Western Electricity Board, has told the Council that it was not a case of Government grants. The Board was going ahead as fast as its physical capacity would allow, but they could not increase the number of linesmen.

Sheffield

The sub-area committee of the Yorkshire Electricity Consultative Council has rejected an appeal against a decision of the Electricity Board to charge a consumer the commercial tariff for a supply to a building converted into flats. It was stated that the building had 22 rooms let off as individual flats, but the electricity supplied was metered at one point.

LIGHTING SCHEMES

Liverpool. The City Lighting Committee has recommended the conversion of existing gas street lighting to electricity, at an estimated cost of £600.000. It is suggested that outside the central development area the work should be completed in 10 years, and, within that area in fifteen years.

Sandwich. The borough surveyor's proposals for the next stage of converting street lighting to electricity have been approved by the T.C.

Wembley. M.o.T. has granted loan sanction for the remaining £15,100 which the Council wishes to borrow to convert gas street lighting to electricity.

COMPANY ACTIVITIES

SURPRISE for the City last week was the news that Marconi International Marine Communication Co. is to raise £410,000 by a share offer. Apart from an issue of £575,000 Unsecured Loan five years ago, this member of the English Electric group has been able to finance ever-growing business since 1919, from its own resources.

The increasing importance of radio and radar equipment has meant further expansion for Marconi, which has now built up a bank overdraft of £480,000. So it is that rather than rely further on temporary borrowing the company offers its shareholders 298,182 £1 shares at 27s. 6d. each in the ratio of one new for four held.

With the current shares quoted at around 34s. 6d. the "rights" to the new issue are worth 1s. 5d. a share.

The directors anticipate that profits for the current year will justify a final dividend (probably in February) at the same rate as would have been recommended without the increase in capital.

Also asking shareholders for more cash is the Watford Electric and Manufacturing Co., which produces automatic electric control gear. The money, some £66,000, will be raised by a combined Preference and Ordinary share issue.

It is needed to finance the purchase and equipment of the company's new factory. To this will go the sheet metal cubicle and spray painting departments. This will leave more space in the main building for manufacture of the company's various control gear specialities.

Though the shares of J. and F. Stone Lighting and Radio were little affected by the record profits of £895,260 announced last week the results were well received by the City. The distribution came up to expectations—50% against an equivalent of 33⅓%.

It should be remembered that the company's trading year ended on 30 June and therefore the accounts do not reflect any benefits likely to result from the Chancellor's recent decision to sweep away the remaining controls on hire purchase. Since then, of course, h.p. sales have had a tremendous boost, and no doubt J. and F. Stone has had its share.

The Perak River Hydro Electric Power Co., whose business it is to supply power to the tin fields of Perak has had a most successful year. During the year to July the company sold a record number of 335,143,943 units. On January 1 it brought into use a new 80,000 lb. per hour boiler at Batu Gajah. The balance sheet reveals a strong liquid position with cash £40,000 higher at £692,243. Tax reserves certificates have also risen—£60,000 to £260,000.

Movements in copper prices this week have been all in favour of buyers. The reaction which I reported last week gradually gained momentum and in the five trading days ending on Friday last, the price for spot copper had fallen £29. 15s. to £263. 15s. a ton. For delivery in three months the fall was £25 to £249. 15s.—*From our City Correspondent.*

Electrical Apparatus Co. Ltd.

There is a final Ordinary dividend of 15%, making 22½% for the year ended 31 July last, compared with 20% for the previous year. The approximate net profit for the period is £100,000 (*£72,414*). A further scrip issue of Ordinary shares is proposed, on a one-for-eight basis. But the board emphasise that this does not mean that the total sum paid on Ordinary dividends will be increased. Proposals are also to be put forward early next year for amalgamating the present two classes of Preference shares into one class by converting the 10% "A" shares into 8% shares and giving holders of "A" shares one extra share for each four now held.

Kalgoorlie Electric Power and Light Corporation Ltd.

As all surplus cash has been utilised towards meeting the company's heavy liabilities on capital account there is to be no dividend for the year ended 31 Dec. last. The net profit for that year is £18,119 (*£10,710*). Taxation relief obtained in respect of initial allowances on plant purchases in past years is more than sufficient to cover taxation liability on profits for the year. Consequent upon the loss of the company's larger consumers there has been a substantial reduction in output since the beginning of the current financial year, and the present position cannot be regarded as satisfactory, the directors report. Efforts to secure additional load, which are being actively explored, are not without promise of success, it is stated.

Kenwood Manufacturing Co., Ltd.

The registered capital of this concern which makes electric mixers and irons, has been increased by £36,000 in £1 Ordinary shares to a total of £51,500.

Marconi International Marine Communication Co. Ltd.

The directors announce a rights issue of 298,182 £1 registered shares on the basis of one new share for every four held. The directors point out that the growth of the business has made heavy demands on financial resources. The bank overdraft has risen from £341,277 at the end of 1953 to about £480,000 and apart from the £575,000 3½% Unsecured Notes finally due in 1957, no issue of capital has been made since 1919.

Newton Brothers (Derby) Ltd.

Some of the heavy backlog of orders which were outstanding at 31 Mar. 1953 were completed and invoiced during the current year so that orders remaining at 31 Mar. last, though still considerable, were somewhat less, Mr F. V. Pipe, the chairman, reports. Export work amounted to 21% of the total production last year, but competition is increasing as the industry of the competing countries continues to expand. It will be seen from our table that last year's figures were a record.

Year to Mar. 31	£ Trading Profit	£ Net Profit	% on Ord. Earned	% on Ord. Paid	Ord. Price High	Ord. Price Low
1950	115,007	43,750	50	15*	4/11	3/-
1951	167,094	60,935	73	13⅛	6/1	4/8
1952	155,070	48,501	58	16⅛	5/6	4/1
1953	181,625	74,445	49	10†	3/7	2/3
1954	278,108	96,303	63	17½	5/1	2/9

*Plus 100% capital bonus. †Plus 75% capital bonus.

Palestine Electric Corpn. Ltd.

On the eve of control of this concern being taken over by the Israeli Government, it is announced that the company has been granted a £1 million sterling loan by Barclays Bank, of London. It is stated that the Israeli Parliamentary Finance Committee has authorised the Government to guarantee the loan, the Bank having made that a condition for granting the loan. The loan is to be used to pay British holders who decided to accept the Government's offer to purchase their holdings against cash.

J. and F. Stone Lighting and Radio

A further jump in profits for the year ended 30 June last is reported in the preliminary statement. The trading profit for the year is £895,261 compared with £761,900 a year earlier. After taxation, etc., the net profit is £310,511 (*£224,240*). In addition to the customary 30% final dividend making a total of 40% for the year (on the larger capital), the Board is repeating the 10% bonus.

Watford Electric and Manfg. Co.

The directors announce rights issues of Preference and Ordinary shares. Preference holders will have the right to take up 88,000 new 10s. Preference shares at 10s. 6d. on the basis of one-for-two. Ordinary holders will have the right to 140,800 new 2s. Ordinary at 4s. 3d. each on a one-for-ten basis.

Dividends Declared

Dowding and Mills Ltd. The dividend is again 50%. Net profit, after taxation, £33,026 (*£24,439*).

Engineering and Lighting Equipment Co. Interim of 15% (*nil*). This interim is the first since 1945-6.

Greengate and Irwell Rubber Co. Interim of 12½% for fifteen months (*10% for 12 months*).

London Electric Wire Co., and Smiths. Interim of 3¾% (*5%*) on doubled capital.

Reliance-Clifton Cables and Industrial Products Ltd. Interim of 10% (*15%*) on capital increased by 75% scrip issue.

River Plate Electricity and Other Securities Corporation. Interim 5% (*4%*).

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

22 Oct.—Londonderry. Installation at New Gransha Hospital.—See 14 Oct. issue.

23 Oct.—Antrim. Electrical repairs, lamps, etc., for S. Antrim Hospital Committee.—See 14 Oct. issue.

23 Oct.—Ebbw Vale U.D.C. Rewiring of 272 houses on Glyncoed estate.—Advertised in 7 Oct. issue.

23 Oct.—Newcastle-upon-Tyne T.C. L.T. lead covered cable.—See 7 Oct. issue.

23 Oct.—Northumberland. A 3 kVA engine driven 230 V a.c. generator.—See 14 Oct. issue.

23 Oct.—Rochester T.C. Three vertical driven non-chokeable centrifugal sewage pumps, with motors, starters, etc.—See 7 Oct. issue.

25 Oct.—Braintree (Essex) R.D.C.—Those wishing to be placed on list of selected tenderers for electrical contracting, supply of electric fittings, etc., should apply by above date to Clerk of R.D.C., St. Peter's Close, Bocking, Braintree.

25 Oct.—Chelmsford T.C. Class A street lamps on various roads.—See 14 Oct. issue.

25 Oct.—Dudley T.C. Supply and erection of Group A lighting along about ¼ mile of A.4123. Apply by above date to Borough Engineer, Council Hse, Priory Rd. Deposit £5. 5s.

25 Oct.—Hindley U.D.C. Sodium lanterns, lamps, control gear, concrete columns, and 102 steel brackets. — See 30 Sept. issue.

25 Oct.—Longbenton U.D.C. Installations in 312 houses at Annitsford, Forest Hall, Palmersville, and Holystone.—See 7 Oct. issue.

25 Oct.—Southall T.C. Provision of street lighting equipment in Norwood and Greenford Rds. Advertised in 7 Oct. issue.

25 Oct.—Sunderland T.C. Electrical installation at St. Columbas junior and infant school. Borough Engineer, 27 Fawcett St. Deposit £2. 2s.

25 Oct.—West Riding. Conversion to electricity at Goole Alexandra Rd school. —See 14 Oct. issue.

26 Oct.—Southgate T.C. Equipment for street lighting schemes.—Advertised in 7 Oct. issue.

27 Oct.—Bath T.C. Installation in 34 dwellings on Fothill estate, and 8 at The Circus.—See 14 Oct. issue.

27 Oct.—Manchester T.C. Installation at Wythenshawe West Secondary Technical School.—See 30 Sept. issue.

28 Oct.—Billesdon (Leic.) R.D.C. Rewiring of council offices at Thurnby. J. W. Stephenson, surveyor, Council Offices, Thurnby.

28 Oct.—Dublin. Supply of electric starter batteries. J. Tyrrell, secretary, Office of Public Works.

28 Oct.—Lancashire. Electrical installation at Haslingden Helmshore county school; and same at Widnes Occupation Centre. Separate contracts. County Architect, P.O. Box 26, County Hall, Preston. Deposit £2 in respect of second contract.

28 Oct.—Strabane (N.I.) Electrical installation in Barrack St primary school. Architects are F. M. Carr and W. H. D. McCormick, 7 Ferryquay St, Derby. Deposit £5. 5s.

28 Oct.—Sale T.C. Relighting of Cross St and Washway Rd (A.56) for about 2·18 miles.—See 14 Oct. issue.

29 Oct.—Donegal C.C. Installation in new district hospital, Carndonagh.—See 30 Sept. issue.

29 Oct.—Dublin T.C. Test instruments for public lighting dept.—See 14 Oct. issue.

29 Oct.—Kirkcaldy T.C. Electrical work in 150 houses.—See 30 Sept. issue.

29 Oct.—Liverpool T.C. Installation at Westminster Rd primary school.—See 14 Oct. issue.

29 Oct.—Llandudno U.D.C. Concrete lighting columns with lanterns.—Advertised in 7 Oct. issue.

29 Oct.—Maybole T.C. 52 lighting points on route A77.—See 7 Oct. issue.

29 Oct.—Manchester T.C. Electrical installation in 19 police houses at Crumpsall, Withington and Longsight. Director of Housing, Town Hall. Deposit £1. 1s.—Advertised in this issue.

29 Oct.—Oswaldwistle U.D.C. Installation in 32 dwellings on White Ash Estate. —See 16 Sept. issue.

30 Oct.—Adwick-le-Street U.D.C. Supply of equipment for sodium discharge lighting on Great North Rd A.1.—Advertised in 7 Oct. issue.

30 Oct.—Peterborough T.C. Lighting and power installations in 138 houses on Walton estate. Apply by above date to L. H. Robjohn, acting city engineer and surveyor, Town Hall. Deposit £2. 2s.—Advertised in this issue.

30 Oct.—Portadown T.C. Supply of flashing beacon units for pedestrian crossings. J. C. Mackinder, Borough Engineer, Tavanagh Hse.

30 Oct.—Swansea T.C. Supply of sodium public lighting equipment.—Advertised in 14 Oct. issue.

30 Oct.—Thornaby-on-Tees T.C. Installation in 86 houses on Gilpin Brown estate. Borough Engineer, Town Hall. Deposit £2. 2s.

1 Nov.—Brighton T.C. Two electrically-driven pumps, control gear valves, recording instruments at Lewes Rd pumping station.—See 14 Oct. issue.

1 Nov.—Edinburgh T.C. Electrical installation in Parks Dept. Offices in Cranston St. City Architect, City Chambers.

1 Nov.—Isle of Wight. Wiring of Council houses at Dodpits, Shalfleet, and Langbridge, Newchurch. Clerk of Council, 30 Pyle St, Newport.

2 Nov.—Fleetwood T.C. Electrical work in 48 houses on West View estate. —See 14 Oct. issue.

3 Nov.—N. Ireland. Lighting and power installations, luminous cell and radio diffusion systems at Mourne Hospital, Kilkeel. Secretary, S. Down Hospital Management Committee, Daisy Hill Hospital, Newry. Deposit £3. 3s.

4 Nov.—Belfast T.C. Installation in Ballysillan intermediate school.—See 14 Oct. issue.

4 Nov.—Bingley U.D.C. Supply and erection of 60 class B concrete columns and lamps with auxiliary gear and wiring. Surveyor, Town Hall. Deposit £2. 2s.

4 Nov.—Preston T.C. Electrical installation at Eldon St. county primary school. Borough Engineer and Surveyor, Municipal Bldg. Deposit £1.

4 Nov.—Twickenham T.C. Street lighting units for stage 1 of Group A scheme in Hampton Area.—See 14 Oct. issue.

4 Nov.—Warrington, T.C. Fluorescent lighting and wiring at general market. Borough Surveyor, Town Hall.

5 Nov.—Belfast T.C. Electric hoist-block and 12 in. bore parallel slide valve for steam plant.—Advertised in 14 Oct. issue.

5 Nov.—Bradford. Supply of lamps during 1955 for hospitals in Bradford A Hospital Management Group. Supplies Officer, Royal Infirmary.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources including an index of trade information with over 100,000 entries

A Selection from the 132 queries answered this week

Electrodes for heat-sealing plastic welding machines, makers of? N.M.L.—E. A. Stallwood, 14 Dorchester Way, Kenton, Harrow; Redifon Ltd., Carlton Hse, Regent St, S.W.1; Wickman Ltd., Oxgate Lane, N.W.2.

"Autoclave" steriliser, makers of? E.M.S.—This item which fitted on top of a hotplate was made by the Almag Eng. Co., Ltd., now out of business. Tempo Aluminium Ltd., 46 Pembridge Rd, W.1, took over some of the company products.

Panel heaters 6 ft in length to be hung from a ceiling, makers of? T.B.C.—Panelec (Gt. Britain) Ltd., 27 Hatchlands Rd, Redhill, Surrey.

20 V fairy lamps containing a coloured liquid which bubbles when heated, makers of? S.W.B.—Telsen Electric Co. (1935), Ltd., Fitzgeorge St, Manchester 9.

"J.C.N." hairdryer rotary switch, makers of? S.E.L.—John Cole Ltd., 45 Chapel Rd, S.E.27.

"Thermidair" convectors, makers of? L.E.B.—Midland Metal Spinnings Ltd., Fort Works, Pelham St, Wolverhampton.

"Cozee Cumfort" blankets, makers of? E.D.A. — Blanella Co., Boston Spa, Yorks.

5 Nov.—N. Ireland. Installation in Gardenmore Presbyterian Church, Larne.—See 7 Oct. issue.

5 Nov.—Westhoughton U.D.C. Street lighting to Group A standard of about 1 mile of Newbrook Rd (A.579). F. H. Walker, Engineer and Surveyor, Town Hall. Deposit £2. 2s.

5 Nov.—Wrexham T.C. Columns, lanterns, lamps and time-switches for Group A and B street lighting. Advertised in 14 Oct. issue.

6 Nov.—Dublin. T.C. Supply of circuit-breakers and condensers for public lighting dept. Finance Dept, City Hall.

6 Nov.—Windsor T.C. Lamps, fittings and cable during 1955.—See 14 Oct issue.

8 Nov.—Aldridge (Staffs.) U.D.C.—Supply and installation of 50 group A street lighting units along Birmingham Rd (A.34). Engineer and Surveyor, 9 Leighswood Rd. Deposit £2. 2s.

8 Nov.—Banstead (Sur.) T.C. Supply and erection of 103 concrete columns and lanterns for joint housing scheme of boroughs of Mitcham, Sutton and Cheam, Merton and Morden. Engineers, A. P. I. Cotterell and Son, 54 Victoria St. Westminster, S.W.1. Deposit £2. 2s.

10 Nov.—Inverness T.C. Electrical work in 26 houses in Diriebught Rd. Burgh Architect, J. Blackburn, 11 High St.

16 Nov.—Hazel Grove and Bramhall U.D.C. Concrete and steel columns, lanterns, etc., along Buxton and Macclesfield Rds.—Advertised in 14 Oct. issue.

17 Nov.—Kincardine. Street lighting for Silverbank housing estate. County Rd. Surveyor, Viewmount, Stonehaven.

18 Nov.—Belfast T.C. Extensions to pneumatic dust removal and surface installation at Power Station West.—Advertised in 14 Oct. issue.

24 Nov.—Littlehampton U.D.C. Electrical installation in 12 houses on Wickbourne estate extension. Engineer and Surveyor, Council Offices. Deposit £1. 1s.

30 Nov.—Tottenham B.C. Lamps wanted in year from 1 Apr.—See 14 Oct. issue.

No date stated—N. of Scotland H.F. Board. Lighting, small power and other services for Ceannacroc power station.—Advertised in 14 Oct. issue.

No date stated.—Southport T.C. Supply and installation of class B street lighting conversions. Lighting Engineer, 117a-123 Shakespeare St.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon House, Theobalds Rd, W.C.1, quoting reference.*

10 Nov.—Australia. Supply of total of 80 single and three-phase distribution transformers between 5 kVA and 250 kVA. Specif. no. 478. Documents from State Electricity Commission, Scottish Union Hse, 127 Eagle St, Brisbane, at £2. 2s.

10 Nov.—India. Damodar Valley Corporation Electrical Department, invites tenders for one 5 MVA 132/133 kV mobile substation with 33 kV switchgear and protective equipment. B.o.T. (Ref.: ESB 24268/54).*

10 Nov.—South Africa. Stores Dept. of S. African Railways, requires total of 3,150 ft underground armoured cable. B.o.T. (Ref.: ESB 24141/54).*

10 Nov.—South Africa. Supply of 4,500 ft paper insulated star quad cable, underground armoured and 74 pair, 10 lb conductor, for Stores Dept. of S. African Railways. B.o.T. (Ref.: ESB 24089/54).*

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, 19 October

	£ per ton	Weekly change £	Price last year £
COPPER, standard class A (settlement)	269	−13½	247½
„ (3 months)	257	−8	227½
LEAD, refined pig, min. 99·97% purity (cash)	107½	−¼	92½
„ (3 months)	102	−1½	89½
TIN, refined, min. 99·75% purity (settlement)	731	−1½	627½
„ (3 months)	732	−½	608½
ALUMINIUM, ingots 99·99·5%	150	—	150
ZINC, virgin, min. 98% purity (cash)	82	−1½	76½
„ (3 months)	81½	−2	73
RUBBER No. 1, RSS, spot (per lb.)	24½d.-25d.	+1d.	16½d.
„ c.i.f. basis, ports. Dec. (per lb.)	22½d.	+½d.	16½d.
ARMOURING:			
Galv. Steel Wire (0·104 in.)	52½	—	50½
Mild Steel Tape (0·014 in.)	40½	—	40

12 Nov.—India. Supply of large quantity of V.I.R. braided and compounded 250V. cable insulated with vulcanised India Rubber single core size 3/·029. Director General of Supplies and Disposals, Shahjahan Rd, New Delhi. B.o.T. (Ref.: ESB 23914/54).*

12 Nov.—South Africa. Supply of total of 7,260 ft of cable to various specifications, and joints. Electricity Department, Corporation of City of Durban, Municipal Bldgs, West St. Contract no. E.2531. B.o.T. (Ref.: ESB 24328/54).*

17 Nov.—Australia. Manufacture, supply, etc., of coal handling plant with driving gear for power station at Blackall. State Electricity Commission, Scottish Union Hse, Eagle St, Brisbane. B.o.T. (Ref.: E.S.B. 23602/54)*.

17 Nov.—New Zealand. Total of 608,400 ft of paper insulated telephone cable, star quad, lead alloy sheathed, steel tape armoured and served, required by Post and Telegraph Dept., Wellington. B.o.T. (Ref.: ESB 23565/54).*

18 Nov.—New Zealand. Following required by Stores Div., G.P.O., Wellington: uninsulated alligator and battery clips, conduit, saddles, connectors, terminal blocks, watertight fittings for lamps, plugs, ceiling roses, sockets and switches. Ref.: P. and T. 150/7368. B.o.T. (Ref.:ESB 24045/54).*

19 Nov.—Thailand. Hydraulic turbines and generators with all necessary electrical and mechanical parts and equipment for Greater Chao Phya project. Royal Irrigation Department, Bangkok. B.o.T. (Ref.: E.S.B. 23851/54)*.

25 Nov.—Pakistan. Supply of (*a*) one 250 MVA interrupting capacity double busbar compound-filled 11 kV switchboard remote control comprising 26 panels; (*b*) one 11 kV control board for above; and (*c*) spares for above. Dept. of Supply and Development, Government of Pakistan, Frere Rd, Karachi. B.o.T. (Ref.: ESB 24096/54).*

2 Dec.—South Africa. S. African Post Office requires two battery operated tractors and charging plant for same. Ref. no. Post Office 1657. B.o.T. (Ref.: 24318/54).*

6 Dec.—Brazil. State Electricity Commission, Porto Alegre, require supply of 3,045 kilometres steel cored aluminium cable of specified types, and 695 kilometres galvanised steel cable, with accessories. B.o.T. (Ref.: ESB 23847/54).*

3 Jan.—Malaya. Supply and installation of four vertical electrically driven sewage pumps for Municipality of Kuala Lumpur. Documents from consulting engineers, J. D. and D. M. Watson, 18 Queen Anne's Gate, Westminster, S.W.1. Deposit £5. 5s.

17 Jan.—Portuguese E. Africa. System of automatic railway points, traffic control installation and signalling equipment required by Ports, Railways and Transport Dept., Lourenco Marques. B.o.T. (Ref.: ESB 23918/54).*

3 Feb.—Australia. Turbo-alternator plant required by Electricity Trust of S. Australia for Port Augusta B power station. Two or 3 units required, 60 MW capacity (MCR), 900 p.s.i. 900° F steam conditions. Specifications available from Preece, Cardew and Rider, consulting engineers, 8 Queen Anne's Gate, Westminster, S.W.1.

Contracts Placed

B.E.A. Coal handling plant at Brighton B, Mitchell Engineering Ltd.; One 360,000 lb/hr boiler at Littlebrook C, International Combustion, Ltd.; Instruments and automatic controls at Willington A, Electroflo Meters, Ltd.; No. 3 Cooling tower at Skelton Grange, Film Cooling Towers (1925) Ltd.; 11 kV and l.v. main and auxiliary cables at Wakefield B, Drake and Gorham (Contractors), Ltd.; Main and auxiliary cables and accessories at Stella North (London Electricity Board); 33 kV switchgear and accessories at Barony, Cooke and Ferguson, Ltd.; and 275 kV twin 0·175 sq in. double circuit line between Uskmouth and Melksham, J. L. Eve Construction Co., Ltd.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Design showing a witch on a broomstick. 722,205. Class 7. Polishing, scrubbing machines etc. S. R. Cowlard Ltd, The Crest, Crumpfields Lane, Redditch.

Invincible. 730,292. Class 9. Scientific and electrical apparatus and instruments, etc. Co-operative Wholesale Society Ltd., 1 Balloon St, Manchester.

Nylex. 730,330. Class 9. Scientific and electrical apparatus etc. Thurgar Bolle (Successors) Ltd, Orient Hse, Church Way, Wellingborough, Northants.

Plastab. 731,407. Class 9. Measuring, weighing and recording apparatus being electronically controlled. British Tabulating Machine Co., Ltd., 17 Park Lane, W.1.

Soldron. B 730,449. Class 9. Electrically heated soldering instrument. K. W. L. Kemp, 14 Leamington Close, Sundridge Pk, Bromley, Kent.

Saxothene. 731,130. Class 9. Insulated cable and wire. Saxonia Electric Wire Co., Ltd, Roan Works, Roan St, S.E.10.

BUSINESS PROSPECTS

Barrow. It is proposed to erect shops on Newbarns (South) housing estate.

Birkenhead T.C. Tenders to be invited for erection of about 258 more houses on Woodchurch estate. Work to start in January.

Birmingham. Research station at Mackadown and The Medway to be built for Birmingham Small Arms Co., Ltd. Bridgewater and Coulton, Queen's College Chambers, Paradise St, are quantity surveyors.

Blackpool T.C. Construction of 113 houses and 72 flats on Grange Park estate extension. Borough Surveyor, A. Hamilton, P.O. Box 17, Municipal Bldgs.

Boldon (Dur.). Insulating Products Ltd. to build new office block in Cleadon Lane. Plans by J. M. Augus, 21 Louvaine Place, Newcastle, have been approved.

Bury St. Edmunds T.C. Construction of 20 houses on Howard estate. Borough Engineer and Surveyor, Borough Offices.

Co. Down. Construction of primary school at Scarva. Bill of quantities prepared by V. B. Evans, 3 Bradbury Place, Belfast.

Croydon T.C. Plans in hand for erection of Ingram secondary girls' school in Spurgeon Rd, costing £142,250.

Dudley T.C. Tenders may soon be invited for erection of 170 houses on Sledmere estate. Sundry other housing schemes also being prepared.

Easington R.D.C. Permission received to build 28 houses by direct labour at Wingate. It is proposed also to erect further 80 houses in same area.

East Lothian. Approval sought for erection of 50 houses each at Prestonpans and Macmerry, and 24 at Gullane.

Eccles. Synthetic Supplies Ltd. are planning to erect single-storey packing and storage factory in Silk St.

Edinburgh. A neuro-surgical dept. to be built at Western General Hospital at estimated cost of £300,000. Quantity surveyors are J. Gentles and Son, 3 Hill St.

Ellesmere Port U.D.C. Erection of 100 flats and maisonnettes on N. Whitby estate. Engineer and Surveyor, Queen St.

Eston (Yorks). Licence for £11,000 issued to I.C.I. Ltd. for lighting of firm's main railway sidings at Wilton works.

Grantham T.C. Electric wiring at the Guildhall to be renewed.

Ilford. D. Bernhardt, of 3 Eagle St, London, W.C.1, have submitted plans for erection of factory, offices and showrooms in High Rd. Also, S. Essex Recorders, Ltd., are planning to extend printing works.

Jarrow-on-Tyne. Northern General Transport Co. Ltd. to build showroom and canteen at bus station. Architects are Fennell and Co., Bridge End Chambers, Chester-le-Street.

Keighley. Approval in principle given to erection of third and fourth floors at Technical College.

Leeds T.C. Erection of 130 dwellings on Swarcliffe, Leacroft estate. City Architect, Priestley Hse, Querry Hill.

Llanelly R.D.C. Construction of 48 houses on Tycroes No. 2 site. Council's Architect, 2 Queen Victoria Rd.

Loftus (Yorks) U.D.C. Five blocks of flats to be built on East Loftus estate. Plans in hand also for further redevelopment of Vauxhall St area comprising erection of 175 dwellings and 13 shops.

Long Eaton U.D.C. Erection of 44 houses and 13 bungalows on Petersham site. F. Turner, Engineer and Surveyor, Town Hall.

Maltby U.D.C. Erection of 7 shops with accommodation on Cliff Hills estate. Architect and Surveyor, Council Offices, Rotherham Rd.

Manchester. Permission sought to borrow £259,706 for erection of Kirkmanshulme Lane grammar school.

March U.D.C. Development of site in Badgeney Rd is beginning. Total of about 178 houses to be built.

Middlesbrough T.C. It is proposed to build 3,500 houses near Ormesby Village. Site works for Pallister Park scheme (second development) expected to begin next year and later site work will begin at Ormesby.

N. Ireland. Erection of 33 dwellings at Keady (Armagh). N.I. Housing Trust, 12 Hope St, Belfast.

Northampton T.C. Total of 71 dwellings including 10-storey block of 38 flats, to be built in centre of the town.

Northumberland. Revised plans for £54,000 for Bedlington Stead Lane infants school approved by E.C. County Architect, C. C. Brown, County Hall, Newcastle-on-Tyne. An old people's home at Stannington is being planned.

Pudsey T.C. Erection of 28 houses on Cemetery Rd (North) site. Borough Surveyor, Town Hall.

Rugby R.D.C. Erection of 34 houses on four sites. Council's Surveyor, 24 Warwick St.

South Shields T.C. Ov r £750 is to be spent on electrical work at grammar technical school for girls. Preliminary plans approved for new secondary school at Brinkburn. Erection of 124 houses on Whiteleas estate. Borough Engineer is J. Reid, Town Hall.

Swansea. Construction of new works and offices in East Approach Rd for Tom Smith and Clarke Ltd. Architects are T. Alwyn Lloyd and Gordon, 6 Cathedral Rd, Cardiff.

Tynemouth T.C. Plans approved in principle for 5-storey blocks of flats and maisonnettes at east end of North Shields. Architects are A. K. Tasker and Austin Child, Trinity Buildings, New Bridge St, Newcastle.

Wanstead and Woodford (Essex) T.C. It is proposed to build 56 houses at Woodford Bridge.

Washingon (Dur.). U.D.C. Layout plans approved in principle for Coach Rd Estate, 569 houses in addition to schools, community centre, church, etc.

Gazette Announcements

COMPANIES ACTS

Electric Truck and Battery Co., Ltd. Liquidator, J. M. Clarke, senior official receiver, Inveresk Hse, Strand, W.C.2, released from 1 Oct.

Fairclough (Leeds) Ltd. Last day for receiving proofs in respect of intended dividends, 27 Oct. Liquidator is W. H. Meredith, official receiver, 29 East Parade, Leeds.

Hunt and Co. (Newark) Ltd. General meeting will take place at Talbot Hse, Talbot St, Nottingham, on 18 Nov. at 12 noon to receive liquidator's report.

K. D. Carter Ltd. Resolution for voluntary winding-up passed at meeting on 6 Oct. R. G. B. Booth of 21 The Avenue, Southampton, has been appointed liquidator by creditors.

Trustful Products Ltd. Liquidator, Bernard Phillips of 76 New Cavendish St, London, W.1, released as from 24 Sept.

A. W. Lines Ltd. Last day for receiving proofs in respect of intended dividends, 4 Nov. Liquidator is A. W. Hunter, Walter Hse, 418-22 Strand, London, W.C.2.

BANKRUPTCY ACTS

Release of Trustee

Ipswich. Leonard A. L. Leech, trading as T. L. Installation Co. (Norfolk and Suffolk) at 129a Fore St, Ipswich. Trustee was C. A. Taylor, official receiver, 3-5 Northgate St, Ipswich.

Dividends

Chelmsford. Gordon P. Woolley, electrician, of 28 Queen St, Southminster, Essex. First and final dividends of 1·567d. in £ payable at office of Official Receiver in Bankruptcy, 58-61 York Terr, Regents Park, London, N.W.1, on 28 Oct.

Hereford. Philip Thomas, electrical engineer trading at 4 New St, Ledbury. Supplemental dividends of 7¾d in £ payable on 29 Oct. at office of Official Receiver, Somerset Hse, 37 Temple St, Birmingham.

Application for Discharge

Bury St Edmunds. Louis W. Aldis, electrical contractor trading at Lyndhurst Cottage, Woolpit, Suffolk. Hearing will be at Shire Hall, Bury St Edmunds, on 9 Nov. at 11 a.m.

TRADE NOTES

New Birmingham Premises. The London Electric Wire Co., and Smiths, Ltd., and its Associates, Frederick Smith and Co., the Liverpool Electric Cable Co., Ltd., and Vactite Wire Co., Ltd., have removed their Birmingham branch to new and larger premises. The address and telephone number is: Lewcos Hse, 119/120 Moseley St, Birmingham 12; Telephone: Victoria 3731/4.

Beama Contract Price Adjustment Formulæ.—*For Electrical Machinery and Equipment.* For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 16 Oct., 1954, shall be deemed to be 150s. 6d; (*b*) "Cost of Material"—the index figure for materials used in the Electrical Machinery Industry published in the Board of Trade Journal on 16 Oct., 1954, is 161·7.

For Turbo-Generating and Allied Plant. For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 16 Oct., 1954, shall be deemed at 150s. 6d. (*b*) "Cost of Material"—the index figures published in the Board of Trade Journal on 16 Oct., 1954, are: Materials used in Mechanical Engineering Industries—151·5. "Blast Furnaces and Iron and Steel Melting and Rolling (40 and 41)"—146·3. The price of brass condenser tubes, ¾ in. o/d 18 s.w.g. published in *The Metal Bulletin* on 15 Oct., is 3s. 10d. per lb.

For outstanding Contracts covered by the B.O.T. Intermediate Products Index. For purposes of calculating variations in (*a*) "Rates of Pay"—the rate of pay for adult male labour at 16 Oct., 1954, shall be deemed to be 150s. 6d.: (*b*) "Cost of Material"—the index figure for Intermediate Products published in the Board of Trade Journal on 16 Oct., is 362·6.

MEETINGS TO NOTE

THURSDAY, 21 OCT.

I.E.E. (London Utilisation). Chairman's address by J. I. Bernard. Savoy Place, W.C.2, 5.30 p.m.

I.E.E. (Irish). Chairman's address by R. C. Cuffe. Trinity College, Dublin, 6 p.m.

A.S.E.E. (Watford). "Electricity in the Paper Making Industry," W. Tait. Clarendon Hotel, Station Rd, 8 p.m.

A.S.E.E. (Kent). "Large Electrical Installations," W. F. Parker. Rose and Crown Hotel, Tonbridge, 8 p.m.

ENGINEERS GUILD. "The Engineer as Artist," Trevor Andrews. Caxton Hall, Westminster, 6 p.m.

CHELMSFORD ENGRNG. SOC. "Modern Developments in Agricultural Electrification," C. A. Cameron Brown. Crompton's Social Hall, 7.30 p.m.

FRIDAY, 22 OCT.

INSTN. OF MECHANICAL ENGRS. "Modern Developments in Use of Large Single Entry Centrifugal Pumps." H. H. Anderson. 5.30 p.m.

I.E.S. (Bath and Bristol). "An Analytical Approach to Industrial Lighting," W. I. Smith. Royal Hotel, Bristol, 6.15 p.m.

INSTN. OF MECH. ENGRS. "Modern Developments in the use of large Single-entry Pumps," H. W. Anderson. 5.30 p.m.

SATURDAY, 23 OCT.

A.S.E.E. (Oxford) "Power Factor Correction," E. A. Benwell. Y.M.C.A., 10 George St, 6.30 p.m.

MONDAY, 25 OCT.

I.E.E. (London Radio). Discussion on "Whether Compatibility is Necessary for Colour TV System in G.B." E. P. Wethey. Savoy Place, W.C.2, 5.30 p.m.

I.E.E. (Mersey and N. Wales). "Service Experience of Effect of Corrosion on Steel-Cored-Aluminium. Overhead Line Conductors." J. S. Forrest and J. M. Ward. Town Hall, Chester, 6.30 p.m.

I.E.E. (N. Eastern). "Aluminium-Sheathed Cables." P. M. Hollingsworth and P. A. Raine. Neville Hall, Westgate Rd, Newcastle, 6.15 p.m.

I.E.E. (S. Midland Radio). "Birmingham-Manchester-Holme Moss TV Cable System." R. J. Halsey and H. Williams. James Watt Memorial Inst., Great Charles St, Birmingham, 6 p.m.

I.E.E. (Western Utilisation). Visit of chairman of Utilisation section. J. I. Bernard. S. Wales Inst. of Engrs., Park Place, Cardiff, 6 p.m.

I.E.S. (Leicester). "Artificial Illumination of Horticultural Crops," A. Calvert. Electricity Board, Charles St, 6 p.m.

I.E.S. (Leeds). Chairman's address, J. R. Bardsley. 24 Aire St, 6.15 p.m.

TUESDAY, 26 OCT.

I.E.E. (London Students). Chairman's address: "History of the Institution." M. C. Cubitt. R.E.M.E. Training Centre, Hazebrouck Barracks, Arborfield, 7 p.m.

I.E.E. (E. Midland). "Combined Magnetisation of Irons." J. E. Parton. Gas Dept., Nottingham, 6.30 p.m.

I.E.E. (E. Midland). Chairman's address by J. H. Mitchell. Cambridgeshire Tech. College, 6.30 p.m.

I.E.E. (N. Eastern). "Earthing." P. W. Cave. Elect. Recreation Club, Carlisle, 7 p.m.

I.E.E. (N.W. Measurements). Discussion on "Will it be possible to abolish Meters Entirely?" H. S. Petch and M. Whitehead. Engrs. Club, Albert Sq, Manchester, 6.15 p.m.

I.E.E. (S. Midland). "Experimental Synthesis of Speech." W. Lawrence. Winter Gardens Restaurant, Great Malvern, 7.15 p.m.

I.E.E. (Hatfield). "Fundamental Electromagnetic Theory." P. Hammond. Tech. College, 7 p.m.

COVENTRY ELECTRIC CLUB. "Motor Control Gear for Light Industrial Drives." T. D. G. Wintle. Elect. Sports and Social Club, Merrick Lodge, St. Nicholas St.

DAIRY SHOW. 68th exhibition at Olympia, London, continuing until 29 Oct.

INCORP. PLANT ENGRS. (W. and E. Yorks). "Heatless Repair of Broken Castings." Leeds Univ., 7.30 p.m.

WEDNESDAY, 27 OCT.

I.E.E. (London Supply). Chairman's address by J. D. Peattie. Savoy Place, W.C.2, 5.30 p.m.

I.E.E. (Sheffield). "Electricity Distribution in Iron and Steel Works." E. C. Slater and T. B. Rolls. Tech. College, Scunthorpe, 7 p.m.

I.E.E. (Rugby). Symposium on "Servo Mechanisms." College of Technology and Arts, 6.30 p.m.

I.E.E. (Bristol Students). "Protection of Electricity Distribution System." S. J. G. Smith. Tech. College, 7.15 p.m.

INST. OF WELDING. Annual meeting.

BRITISH INSTN. OF RADIO ENGRS. (London). Annual meeting (6 p.m.) and presidential address (7 p.m.) by Rear Admiral (L) Sir Philip Clarke. School of Hygiene, Keppel St, W.C.1.

INST. OF FUEL (N. Western). "Account of American Fuel Research and Work of New Fuel Efficiency Service." Dr W. A. Macfarlane. Engrs. Club, Albert Sq, Manchester, 2.15 p.m.

INSTN. OF MECH. ENGRS. Discussion on "Units of Measurement of length, mass and force employed in the teaching of applied mechanics and general mechanical engineering subjects." 6.45 p.m.

BATTI-WALLAHS SOC. Luncheon. Speaker: Sir Bruce White, Connaught Rooms, 12.45 p.m.

THURSDAY, 28 OCT.

INCORP. PLANT ENGRS. (Sheffield). "Boiler Feedwater Treatment for Industrial Problems." C. J. Carter. Grand Hotel, 7.30 p.m.

E.P.E.A. (S. Western). "Art of Public Speaking." Gordon Rankin. Electricity Hse, Colston Ave, Bristol, 7.15 p.m.

FRIDAY, 29 OCT.

I.E.E. (E. Midland). Kettering annual ball at George Hotel.

I.E.E. (N. Staffs). "Continuity of Electricity Supply." H. Leyburn. Elect. Showrooms, Stoke, 7 p.m.

I.E.E. (Southern). "Loudspeaker Systems —Recent Trends in Loudspeaker Design." Maj. A. E. Falkus. Tech. College, Weymouth, 6.30 p.m.

INSTN. OF MECHANICAL ENGINEERS. Parsons Memorial Lecture: "Factors Influencing Continuing Development of Steam Turbine." F. Dollin, 5.30 p.m.

MANCHESTER ASSOC. OF ENGRS. "Testing Lubricants for Prevention or Promotion of Wear," T. B. Lane, Engrs. Club, Albert Sq, 6.45 p.m.

E.P.E.A. (Southern) "Corrosion in Power Stations," R. S. Thornhill. B.E.A. Headquarters, 111 High St, Portsmouth, 7.30 p.m.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, W.C.2.

Forest Battery Service Ltd. 51 Neverne St, Lydney, Glos. Nom. cap.: £2,000. Manufacturers of and dealers in wireless and television sets, accessories and apparatus, etc. Dirs.: not named. Subs:. A. M. Jones, 21 Park Place, Cardiff and A. G. Reed, 12 Pentrych St, Cardiff.

J. J. Parkinson and Co., Ltd. 5 Cray Bldgs, High St, Foots Cray, Kent. Manufacturers of and dealers in electrical and mechanical apparatus and accessories, wireless, radio and television sets, etc. Nom. cap.: £500. Dirs.: J. J. Parkinson and F. L. Chatfield.

Washington Transformers Ltd. Washington Steel Works, Washington, Co. Durham. Manufacturers of and dealers in transformer tanks with or without cooling elements, radiators and parts thereof, etc. Nom. cap.: £100. Dirs.: S. Hunter and G. Blair.

Ballamy Developments Ltd. Upper Hinton Chambers, Bournemouth. Mechanical, electrical, motor, hydraulic and general engineers, etc. Nom. cap.: £100. Permnt dirs.: L. M. Ballamy, L. W. F. Harris and Mrs I. M. Kent.

Heat Insulation and Ventilation Contracting Co., Ltd. Nom. cap.: £100. Dirs.: C. E. M. B. Hole, 708 Frobisher Hse, Dolphin Sq, S.W.1; and K. N. Powell, Ashe Park Cottage, Ashe Park, nr. Basingstoke.

Hole and Powell Ltd. To take over business of general agents and merchants carried on as "General Sales Co" by Chas. E. M. B. Hole and Kenneth N. Powell, importers and exporters of and dealers in electrical and household goods, machinery textiles, etc. Nom. cap.: £100. Dirs. C. E. M. B. Hole, 708 Frobisher Hse, Dolphin Sq, S.W.1; and K. N. Powell, Ashe Park Cottage, Ashe Park, nr. Basingstoke.

Light Vision Ltd. c/o Arbeid and Co., 63/5 Piccadilly, W.1. Inventors, designers, patentees, licensees and manufacturers of and dealers in radio, television, radar, refrigerators, washing machines, etc. Nom. cap.: £150. Dirs.: to be apptd. by subs. Subs.: C. W. Batley, 32 Shakespeare Rd, Worthing; and M. W. Watkins, 15 The Little Boltons, S.W.10.

Electronic Insurance and Maintenance Co., Ltd. Nom. cap.: £1,000. Dirs.: J. D. Rose and Daisy Rose, 4 Glendaural Court, Milton Rd, Southend-on-Sea.

Busby Electrical Co., Ltd. 66 Heath Park Rd, Romford, Essex. Manufacturers of and dealers in electrical and mechanical apparatus, wireless and television sets etc. Nom. cap.: £1,000. Dirs.: V. H. Busby, Mrs M. Busby, and R. C. Busby.

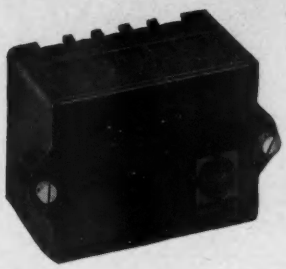
Newgate Electrics Ltd. 11 Saville Row, Newcastle-on-Tyne, 1. Mechanical and electrical engineers, etc. Nom. cap.: £2,000. Dirs.: R. Anderson and Mrs W. E. Anderson.

Marlow Electrical Co., Ltd. 7 Bridge St West, Manchester 3. To take over business carried on as "Marlow Electrical Company" by Isaac Merwitzer at Manchester. Nom. cap.: £1,200. Dirs.: I. Merwitzer and Mrs J. R. Merwitzer.

Cameron Electric Co., Ltd. 405 Coldharbour Lane, Brixton, S.W.9. To take over business of radio, television and electrical engineers carried on as "Cameron Electric Co" at Coldharbour Lane, S.W.9. Nom. cap.: £1,000. Dirs.: W. Tweedley, Mrs E. Tweedley and L. Tweedley.

Owik Electrics Ltd. 9 Blackfriars St, Salford 3. Manufacturers of and dealers in domestic appliances, dealers in washing and cleaning machines, radios, gramophones, television, etc. Nom. cap.: £1,000. Dirs.: E. L. Silverstone and Diana Silverstone.

For neater and more efficient installations



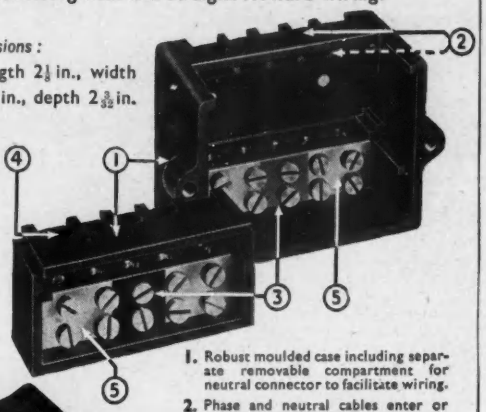
HENLEY

CONNECTOR BOX

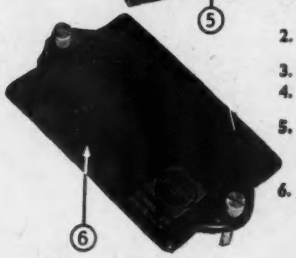
MULTI-WAY DOUBLE-POLE INSULATED

This box is designed for all situations where a number of sub-circuits are required to be connected to a main circuit as commonly experienced in domestic, commercial and similar installations such as at metering positions. The two connectors are separately housed and are arranged so that the phase and neutral cables for each circuit leaving or entering the box are adjacent to each other, thus providing neat and straight-forward wiring.

Dimensions:
length 2⅛ in., width 3 7/16 in., depth 2 3/32 in.



1. Robust moulded case including separate removable compartment for neutral connector to facilitate wiring.
2. Phase and neutral cables enter or leave adjacent to each other.
3. Phase and neutral identification.
4. 'Knock-out' diaphragms for each cable entry.
5. Five-way connectors, two ways up to .04 sq. inch and three up to .0225 sq. inch, fitted with two tinned brass pinching screws for each conductor.
6. Reversible moulded cover retained by two captive screws with provision for sealing.



Ask for folder 43/A

HENLEY

INSULATED SERVICE FUSES

100 AMP now available

This new range of Insulated Service Fuses, suitable for working currents up to 100 amperes, is similar in design to the popular HENLEY Series 3 Fuses.

The range consists of single-pole fuses and double-pole and four-pole fuses with combined Sealing Chambers. Separate Connector Boxes and Sealing Chambers are also available for use with the single-pole fuses.

Ask for folder 43/B

These are two interesting items from the extensive range of HENLEY Insulated Service Fuses, Connector Boxes, etc.

Please write for Catalogue 43

HENLEY

Electrical Distribution Equipment

W. T. HENLEY'S TELEGRAPH WORKS COMPANY LIMITED, 51-53 HATTON GARDEN, LONDON, E.C.1

PHILIPS

NEW

400 Watt Colour-Corrected Mercury-Fluorescent Lamp

★ ★ ★ ★ **MBF/U** ★ ★ ★ ★

★ *16,800 lumens average through life*

★ *Long Life*

★ *Reduced Size*

Details on request

PHILIPS ELECTRICAL LTD.

LIGHTING DIVISION, CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2.

LAMPS · LIGHTING · RADIO · TELEVISION · 'PHILISHAVE' DRY SHAVERS · RECORD PLAYING EQUIPMENT · GRAMOPHONE RECORDS · 'PHOTOFLUX' FLASHBULBS · ETC.

PHILIPS

(770)

CLASSIFIED ADVERTISEMENTS

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 32s. 6d. per inch, and all other classified advertisements at 2s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

TENDERS INVITED

CITY OF MANCHESTER
Watch Committee

TENDERS are invited for Electrical Installations to Police Houses on the following sites.

Hermitage Road, Crumpsall 8 houses.
Meltham Avenue, Withington 6 houses.
Albert Place/Mead Grove, Longsight .. .. .. 5 houses.

Schedules and tender forms may be obtained on application to the Director of Housing, Town Hall, Manchester 2, on payment of a deposit of one guinea (returnable on receipt of a bona fide tender) and must be returned in a sealed official envelope endorsed "Electrical Installations," and be received by the Town Clerk not later than noon on Friday, 29 Oct., 1954.

PHILIP B. DINGLE,
Town Clerk.
(N 482)

CITY OF PETERBOROUGH

THE Council invites Tenders from recognised electrical contractors for the electric lighting and power installations to 138 permanent houses on the Walton Estate, Peterborough.

Drawings, Specifications and Forms of Tender, may be obtained on application to Mr L. H. Robjohn, M.B.E., A.M.I.C.E., A.M.I.MUN.E., Acting City Engineer and Surveyor, Town Hall, Peterborough.

Applications before noon on Saturday, 30 Oct., 1954, should be accompanied by a cheque for £2. 2s. made payable to the Peterborough City Council. This will be returned on receipt of a bona fide tender or the return of the documents.

C. PETER CLARKE,
Town Clerk.

Town Hall,
Peterborough.
12 Oct., 1954. (N 458)

BOROUGH OF WREXHAM
GROUP "A" AND "B" STREET LIGHTING

TENDERS are invited for the supply and erection of the following items:

54 No. Cast Iron Columns and brackets having a mounting height of 15 ft.

30 No. Steel Columns and brackets having a mounting height of 25 ft.

16 No. 250 W Mercury Vapour Lanterns and lamps.

14 No. 140 W Sodium Vapour Lanterns and lamps.

5 No. Triple 80 W Fluorescent Lanterns and lamps.

20 No. Timeswitches.

Conditions of Contract may be inspected at the office of the Borough Engineer and Surveyor, 31 Chester St, Wrexham, from whom copies of the Specification and Forms of Tender may be obtained.

Tenders in the appropriate plain envelope sealed and endorsed "Street Lighting" should reach the undersigned not later than first post on Friday, 5 Nov.

continued in next column

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The Council do not bind themselves to accept the lowest or any tender.

PHILIP J. WALTERS,
Guildhall, Town Clerk.
Wrexham.
Oct. 1954. (N 389)

APPOINTMENTS VACANT

Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18–64, or a woman aged 18–59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or is otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.

SOUTHERN ELECTRICITY BOARD
SUB-AREA TRANSPORT OFFICER

APPLICATIONS are invited for the position of Sub-Area Transport Officer, No. 3 (Portsmouth) Sub-Area, based at the Board's Offices, Lower Drayton Lane, Cosham, Hants.

The Sub-Area Transport Officer is responsible to the Sub-Area Secretary for the co-ordination, maintenance and administration of a mixed decentralised fleet of 350 petrol vehicles.

Applicants must have had experience in the management of road transport, preferably with a public utility in Great Britain, with particular reference to the control and maintenance of vehicles and mobile plant. A knowledge of road transport legislation and familiarity with modern vehicle costing methods are essential qualifications.

The salary will be in accordance with Grade 6 of the N.J.C. Agreement (£730/£805 per annum). The successful applicant will be required to contribute to the B.E.A. and Area Board's Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, No. 3 (Portsmouth) Sub-Area, Lower Drayton Lane, Cosham, Portsmouth, and endorsed Sub-Area Transport Officer, should be returned to the Sub-Area Secretary by not later than 6 Nov., 1954.

JUNIOR ENGINEER

Reading District of No. 2 (Newbury) Sub-Area. Salary will be fixed according to the successful applicant's experience and qualifications in accordance with Clause 35 of the N.J.B. Agreement, i.e. the current maximum will be £491 per annum.

The duties of the post will be to assist with distribution duties including minor construction work and general maintenance. Applicants should have received Technical training to O.N.C. standard and have experience of similar work.

The successful candidate for the above appointment will be required to contribute to the B.E.A. and Area Boards' Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, and returned to him in envelopes suitably endorsed, not later than 6 Nov., 1954. (N 480)

SOUTH EASTERN ELECTRICITY BOARD
SENIOR ASSISTANT COMMERCIAL ENGINEER
Croydon and West Kent Sub-Area

SALARY £1,076/£1,121 p.a. including London Addition under N.J.B. Class J, Grade 4. Superannuable. Applicants must have had wide and responsible experience in the development of electricity supplies for all purposes; in the organisation of showrooms, exhibitions and sales publicity, and in the installation, testing and maintenance of consumers' wiring and apparatus. Recent experience in the agricultural applications of electricity and in the organisation of training for sales and contracting staff would be an advantage.

The successful candidate will be responsible to the Sub-Area Commercial Officer for the sales and contracting, and general consumer development aspects of the sub-area organisation. Preference to those who are Corporate Members of the Institution of Electrical Engineers or hold equivalent qualifications.

Applications on forms from T. A. D. Honnor, M.I.E.E., Croydon and West Kent Manager, SEEBoard, Electric Hse, Wellesley Rd, Croydon, by 3 Nov., 1954.

DEMONSTRATOR
Sevenoaks District

Salary £400 by £20—£480 by £10—£490 p.a. under N.J.C. Grade 1. Applicants should have showroom experience, be capable of demonstrating electrical appliances both in showrooms and on consumers' premises, and possess a recognised diploma or certificate in domestic science and the E.A.W. certificate.

Applications on forms from H. F. Gill, District Manager, SEEBoard, Electric Hse, West Hill, Oxted, Surrey, to be returned naming 2 referees by 3 Nov., 1954.

JOINTER
(Extra High Tension)
Dorking and Epsom District

Wages 3s. 9d. per hour for a 44-hour 5-day week under N.J.I.C. Agreement. This post is at Dorking but the successful applicant may be required to work anywhere in the Dorking and Epsom District.

Applications naming 2 referees to W. B. Hayden, M.I.E.E., District Manager, SEEBoard, 56 South St, Dorking, by 3 Nov., 1954.

A. L. BURNELL,
Secretary.
(N 472)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments, which are superannuable and subject to medical examination:

THIRD ASSISTANT ENGINEER required in the No. 1 Sub-Area Engineer's Technical Department, Liverpool. Salary £766/£794 per annum (N.J.B. Class L, Grade 10).

Applicants should have had a thorough technical training, and possess technical qualifications to enable them to become Chartered Electrical Engineers. Practical experience in the testing and commissioning of protective systems is essential, and duties include the testing of relays and protective gear, high voltage testing of cables, switchgear, transformers, etc., fault calculations and relay settings.

Application forms obtainable from the Manager, No. 1 Sub-Area, 24 Hatton Gdn, Liverpool 3. Closing date: 1 Nov., 1954.

COMMERCIAL ASSISTANT (Technical) required in the Northwich District of the Board's No. 2 Sub-Area. Salary £524/£540 per annum. (N.J.B. E.11).

Applicants should have had a sound technical training. Possession of the H.N.C. in Electrical Engineering advantageous. Duties include dealing with general consumer enquiries on the use and supply of electricity, including estimating for installation work.

Application forms obtainable from the Manager, No. 2 Sub-Area, Sandiway Hse, near Northwich, Cheshire. Closing date: 1 Nov., 1954. (N 433)

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following vacancies:

Chilterns Sub-Area

GENERAL ASSISTANT ENGINEER
153/54R.
Aylesbury District

Candidates should have had a sound training in electrical engineering and experience in the construction, operation and maintenance of underground and overhead systems, including substations.

Salary in accordance with Class E, Grade 11 of the National Joint Board Salary Agreement commencing at £524.

Apply to the District Manager, Eastern Electricity Board, Exchange St, Aylesbury, Bucks.

Northmet Sub-Area

JUNIOR ENGINEER
Meter Testing Laboratories,
New Southgate, London, N.11

Candidates should have had a good general and technical education. A knowledge of the repair, testing and commissioning of meters and metering equipment for domestic and industrial supplies will be an advantage.

Salary in accordance with Class N, Grades 22-18 of the National Joint Board Salary Agreement within a range of £402/£544 plus London Allowance.

Apply to the Manager, Northmet Sub-Area, Eastern Electricity Board, Northmet Hse, Southgate, London, N.14.

Future salary and conditions of service for both these appointments will be in accordance with agreements made from time to time by the appropriate negotiating bodies.

The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Applications, by letter, stating age, education, qualifications and experience with details of present appointment and salary, should be submitted to the Manager concerned within fourteen days of the appearance of this advertisement. (N 477)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

GENERAL ASSISTANT DISTRICT ENGINEER, WALSALL DISTRICT, WOLVERHAMPTON AND DISTRICT SUB-AREA

Applicants should have had a sound technical training and experience in the construction, maintenance and operation of overhead and underground systems and substations. Technical qualifications desirable. Salary £548/£565 per annum (N.J.B. Class "F," Grade 11). Apply, in writing, within 14 days stating age, experience, present salary and position to Mr F. J. Elliott, Sub-Area Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

GENERAL ASSISTANT DISTRICT ENGINEER, LEOMINSTER DISTRICT, SHROPSHIRE AND HEREFORDSHIRE SUB-AREA

Applicants should have had a sound technical training and experience in the construction, maintenance and operation of overhead and underground systems and substations. Technical qualifications desirable. Salary £502/£521 per annum (N.J.B. Class "C," Grade 10).

DEMONSTRATOR, LUDLOW DISTRICT, SHROPSHIRE AND HEREFORDSHIRE SUB-AREA

Applicants must have had a good education and should have a certificate of a recognised Domestic Training College and/or the E.A.W. Certificate. Duties include lecture demonstrations in Service Centres, and on consumers' premises, and advising consumers on the selection and use of electrical appliances. Salary £400/£490 per annum (N.J.C. Grade 1).

Apply, in writing, within 14 days, stating age, experience, qualifications, present position and salary to Mr W. Winwood, Sub-Area Manager, Midlands Electricity Board, Spring Gardens, Ditherington, Shrewsbury.

A. STEPHENS,
Secretary.
(N 478)

HER MAJESTY'S OVERSEA CIVIL SERVICE

RADIO ENGINEER, SOCIAL DEVELOPMENT DEPARTMENT TANGANYIKA

TO be responsible for the operation and maintenance of the 20 kW and 1·25 kW transmitters, and two 250 W R.C.A. transmitters of the Dar-es-Salaam Broadcasting Station.

Appointment pensionable on probation in salary range £1,134/£1,296 per annum including temporary cost of living allowance.

Free passages are granted to officer, wife and children up to the cost of three adult passages. Government quarters, if available, are provided at low rental. Leave is granted at the rate of six days for each month of resident service.

Candidates should preferably be under 35 years of age and have had experience with high power broadcasting transmitting equipment. An engineering degree or other professional qualification is desirable.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith St, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number BCD 178/8/05. (N 463)

BRITISH ELECTRICITY AUTHORITY
Eastern Division

APPLICATIONS are invited for the following post:

JUNIOR ENGINEER
RYE HOUSE GENERATING STATION

Salary Class G, Grade 16, £402—Grade 14, £491 per annum.

Duties include assisting in the Electrical Control Room and experience in the technical operation of electrical, boiler house and turbine house plant, testing, etc., in a Generating Station and provide a suitable basis for promotion to higher technical grades.

Previous experience in a Generating Station and/or technical training to the standard of the Ordinary National Certificate or its equivalent will be of advantage.

Applications stating age, qualifications and experience should be sent to the Controller, British Electricity Authority, Eastern Division, Northmet Hse, Southgate, N.14, by 30 Oct., 1954.

W. N. C. CLINCH,
Controller.
(N 449)

LONDON ELECTRICITY BOARD

APPLICATIONS are invited for the following positions at the Board's Training Centre in Central London.

APPRENTICES' INSTRUCTORS. The Instructors will work under the Training Centre Supervisor and they should have been skilled craftsmen with some previous experience in instructing. They should be capable of teaching any of the basic workshop skills with hand or machine tools, including gas and electric welding and smithing if required. Possession of a City and Guilds certificate or other trade, technical or teaching qualification will be an advantage.

The posts are graded under Schedule "C" of the National Joint Board agreement as Class AX/DX, Grade 8, and the salary range will be £526. 1s. per annum to £728. 14s. per annum, inclusive of London Allowance. The successful candidates will be required to work such hours as may be necessary in order to effectively supervise apprentices under instruction.

FITTER (MECHANICAL). Duties will include maintenance of machines and equipment generally, care of tools and stores, preparation of stock, fabrication of special equipment and operation of the visual-aids apparatus.

N.J.I.C. rates of pay and conditions of employment, 4s. 1d. p.h., £8. 19s. 8d. per 44-hour, 5-day week.

Application forms obtainable from Personnel Officer, 46 New Broad St, E.C.2, to be returned within 10 days of the publication of this advertisement. Please state post preferred, enclose self-addressed envelope and quote ref.: V/1812/T on envelope and all correspondence. (N 475)

YORKSHIRE ELECTRICITY BOARD
No. 5 (Wakefield) Sub-Area

FIRST ASSISTANT DISTRICT ENGINEER
Doncaster District

APPLICANTS must have had a sound practical training and considerable experience in all branches of electricity distribution work covering Industrial, Urban and Rural areas with underground and overhead systems. Corporate Membership of the Institution of Electrical Engineers or equivalent qualification is essential.

Applicants must hold a current driving licence and be prepared to reside in the district.

Salary—N.J.B. Class F, Grade 5, £791/£818 per annum.

GENERAL ASSISTANT DISTRICT ENGINEER
Barnsley District

Applicants must have had a sound practical training with experience in the construction, operation and maintenance of H.V. and M.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Applicants must hold a current driving licence, be prepared to reside in the district, and undertake standby duties.

Applicants must hold at least the Higher National Certificate in Electrical Engineering.

Salary—N.J.B. Class F, Grade 11, £548/£565 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a Denby Dale Rd, Wakefield, not later than 4 Nov., 1954. (N 462)

SOUTH WEST SCOTLAND ELECTRICITY BOARD
Lanarkshire Sub-Area

APPOINTMENT OF GENERAL ASSISTANT ENGINEER (CONSTRUCTION)

APPLICATIONS are invited for the appointment of General Assistant Engineer in the Sub-Area Construction Department at Hamilton.

Candidates should be Graduates of the Institution of Electrical Engineers (or hold equivalent qualifications). They should have had a sound engineering training and have some experience of construction work appertaining to a large distribution system.

The Salary and Conditions of Service will be in accordance with the National Joint Board's Agreement, Schedule "A," the present Classification and Grading being K.13, Salary £583/£605 which will be subject to the statutory deductions including superannuation. The successful candidate will require to reside within a reasonable distance of the Sub-Area Offices at Hamilton.

Application Forms, which may be obtained from the undersigned, should be forwarded to this office not later than Wednesday, 27 Oct., 1954.

DUGALD SMITH,
Manager.

137 Almada St,
Hamilton. (N 473)

BRITISH ELECTRICITY AUTHORITY
North Eastern Division

APPLICATIONS are invited for the appointment of THIRD ASSISTANT ENGINEER in the Steam Testing Department with Headquarters at Dunston Power Station.

Applicants should possess minimum qualifications of Higher National Certificate in Mechanical Engineering and have a good knowledge of thermodynamics. Previous experience in testing of Power Station Plant is essential.

The salary for the appointment (which is superannuable) will be in accordance with Grade 5, Schedule "C" of the National Joint Board Agreement (£649/£835) per annum and will commence at a point commensurate with qualifications and experience.

Forms of application may be obtained from Divisional Establishments Officer, British Electricity Authority, North Eastern Division, Carliol Hse, Newcastle-upon-Tyne, to whom they should be returned to arrive not later than 3 Nov., 1954. (N 434)

HER MAJESTY'S COLONIAL SERVICE

APPLICATIONS are invited for the following posts:

BROADCASTING ENGINEERS

Applications are invited from radio engineers for eventual appointment as broadcasting engineers in the Government broadcasting services of Colonial and Oversea Territories.

Applicants should be over the age of 28 and be Graduates of the Institution of Electrical Engineers or in possession of an Engineering Degree or Diploma recognised as granting exemption from Sections A and B of the Institution's examination. Experience in the radio industry or in the radio branches of Her Majesty's Services for at least two years is necessary but applicants need not have experience directly related to broadcasting.

Successful applicants will receive operational training in the B.B.C. and at any time within two years after initial engagement, they will be required to take up contract appointments with a Colonial or Oversea Government in any part of the world, as broadcasting engineers. Choice of territory will be given where possible, but is not guaranteed.

Total emoluments during training in the U.K.—£800 per annum. Salary on appointment to a Colonial territory will not be less than £1,000 per annum plus such allowances as are prescribed under the regulations of the Territory concerned.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith St, S.W.1, giving briefly age, qualifications and experience. Mention the reference number BCD 96/02/D10. (N 494)

BRITISH ELECTRICITY AUTHORITY
East Midlands Division

APPLICATIONS are invited for the following positions within the Division:

SECOND ASSISTANT CHEMIST
LINCOLN POWER STATION
Vacancy No. 157/54/ET

Preference will be given to candidates who hold the Higher National Certificate in Chemistry, but holders of the Ordinary National Certificate in Chemistry will be considered.

The salary will be in accordance with Class E, Grade 11 (£524/£540 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 1 Nov., 1954.

THIRD ASSISTANT ENGINEER
DIVISIONAL HEADQUARTERS
Vacancy No. 158/54/ET

Applicants should hold a degree in Civil Engineering, be Corporate Members of the Institution of Civil Engineers or possess equivalent qualifications.

They should have had experience in the design and construction of heavy foundations, river works, structures in reinforced concrete and steel and other civil engineering works associated with the design and construction of Power Stations.

Experience in the preparation of specifications, bills of quantities and estimates will be an advantage.

The salary for the appointment will be within Schedule C, Class AX/DX, Grade 5 (£649/£858 per annum.) of the National Joint Board Agreement.

Closing date for receipt of applications, 1 Nov., 1954.

THIRD ASSISTANT ENGINEER (CONSTRUCTION) TRANSMISSION DEPARTMENT,
DIVISIONAL HEADQUARTERS
Vacancy No. 159/54/ET

Applicants must have had experience in the construction of E.H.T. Lines in the field from initial profile to final sag checking. Experience of pre-cast concrete structures and mass foundations will be an advantage.

Preference will be given to applicants who hold qualifications leading to Corporate Membership of Institution of Civil or Electrical Engineers, or equivalent qualifications.

The salary for this appointment will be within Schedule C, Class AX/DX, Grade 5 (£649/£858 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 8 Nov., 1954.

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SENIOR DRAUGHTSMAN (ELECTRICAL)
CONSTRUCTION DEPARTMENT
Vacancy No. 114/54/ET

Candidates should have experience in the preparation of layouts and diagrams for the installation of E.H.T. and L.T. switchgear, transformers, E.H.T. and L.T. cables; knowledge of protective gear systems would be an advantage.

The salary will be in accordance with the National Joint Board Agreement, Grade 4 (£671/£780 per annum) or Grade 5 (£567/£671 per annum) of Schedule D, according to experience.

Closing date for receipt of applications, 1 Nov., 1954.

These appointments will be pensionable within the terms and provisions of the British Electricity Authority and Area Boards Superannuation Scheme.

Applications should be submitted on the official form A.E.6/ACT which may be obtained from the Divisional Establishments Officer, British Electricity Authority, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. Please quote Vacancy Number.

L. F. JEFFREY,
Divisional Controller.
15 Oct., 1954. (N 481)

DUDLEY AND STAFFORDSHIRE TECHNICAL COLLEGE

APPLICATIONS are invited for the post of ASSISTANT LECTURER in Electrical Engineering. Applicants must have had adequate industrial experience, and must be professionally qualified. Duties will begin on 1 Jan., 1955. Salary on Grade A of the Burnham Technical Report (£450 x £18—£725) with allowances, where appropriate, for graduate qualifications, training and experience.

Application forms and further particulars may be obtained from the Principal, Dudley and Staffordshire Technical College, Dudley, to whom the completed forms must be returned as soon as possible.

A. W. GIBSON,
Principal.
(N 423)

BRITISH ELECTRICITY AUTHORITY
London Division

ASSISTANT ENGINEER (ELECTRICAL)
BRUNSWICK WHARF GENERATING STATION

APPLICATIONS are invited for the above superannuable post. Applicants should have experience in testing and calibrating electrical protective gear. Qualifications entitling to Graduate Membership of the I.E.E. an advantage. Conditions of service and salary in accordance with N.J.B. Agreement, Schedule A, Class K, Grade 13 =£612. 3s. including London Allowance.

Applications quoting vacancy No. 54/882, may be made on form obtainable from Divisional Secretary, British Electricity Authority, London Division, P.O. Box 136, Generation House, Great Portland St, W.1, and be received within 14 days of this advertisement. (N 461)

THE NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF SUB-AREA CONSUMERS' ENGINEER,
NO. 1 SUB-AREA, MANCHESTER

APPLICANTS should have held a responsible post within the Electricity Supply Industry, and should preferably be Corporate Members of the Institution of Electrical Engineers.

Duties include the supervision of all commercial activities in the Sub-Area. A wide knowledge of industrial, commercial and domestic electrification is essential.

Salary: N.J.M. and H.E. Grades Committee—Grade 5, £1,750/£1,900 per annum.

Applications, stating age, qualifications and experience, present post and salary should be received by the Establishment Officer, The North Western Electricity Board, Cheetwood Rd, Manchester, 8, by 6 Nov., 1954. (N 431)

BRITISH ELECTRICITY AUTHORITY
Yorkshire Division

require a GENERAL ASSISTANT ENGINEER (Electrical) in the Generation Construction Department, Leeds.

Salary £501/£714 per annum. Class AX/EX, Grade 8, National Joint Board Agreement (Schedule C).

Applicants should have had a sound technical training and preferably be Graduates of the Institution of Electrical Engineers or equivalent, and be experienced in modern power station electrical equipment and drawing office practice.

Application forms obtainable from the Divisional Secretary (Establishments), British Electricity Hse, St. Mary's Rd, Leeds 7, to be returned within 14 days of the appearance of this advertisement.

G. A. VOWLES,
Divisional Controller.
(N 479)

LONDON ELECTRICITY BOARD

ENGINEERING DRAUGHTSMEN

APPLICATIONS are invited for the above positions in the District Drawing Offices of the Southern Sub-Area. The successful candidates will be located initially at Beckenham, Kent.

Candidates should have had a good general and technical education and be experienced in one or more of the following subjects: drawing office routine, electrical diagrams, obtaining and recording all mains work, and plant layout in transformer chambers.

The posts are graded under Schedule "D" of the National Joint Board agreement as Grade 6—£458 to £595. 7s. per annum, inclusive of London Allowance.

Application forms obtainable from Personnel Officer, 46 New Broad St, E.C.2, to be returned completed by 31 Oct., 1954. Please enclose addressed envelope and quote Ref.: V/1828/1749/T. (N 404)

COUNTY BOROUGH OF WEST HAM EDUCATION COMMITTEE
West Ham College of Technology
Romford Road, Stratford, E.15

Principal:

E. A. Rudge, PH.D., M.SC., A.M.I.CHEM.E.

APPLICATIONS are invited for the post of ASSISTANT LECTURER, Grade A, in the Electrical Engineering Department. Candidates should have a degree, or equivalent qualification, together with industrial experience, and should be able to teach in the field of Electrical Power and Machines.

Salary in accordance with the Burnham Technical Scale (Grade A).

Forms of application and particulars may be obtained from The Principal on receipt of a stamped addressed envelope, and should be returned not later than 29 Oct. (N 432)

BRITISH ELECTRICITY AUTHORITY
North West, Merseyside & N. Wales Division

APPLICATIONS are invited for the appointment of OPERATION AND EFFICIENCY ENGINEER at the Bromborough Power Station, Cheshire. Salary £885/£923 per annum, Class H, Grade 5, N.J.B. Superannuable and subject to medical examination.

Candidates should preferably be Associate Members of the Institute of Mechanical or Electrical Engineers or possess equivalent qualifications and have a sound and technical education with practical experience in the operation, maintenance and testing of modern steam power stations.

Application Forms may be obtained from the Divisional Controller, Beaconsfield Rd, Woolton, Liverpool. Closing date: 5 Nov., 1954. (N 460)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2.

THE NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF
(*a*) THIRD ASSISTANT ENGINEER (MAINS)
(*b*) ENGINEERING DRAUGHTSMAN
CONSTRUCTION SECTION,
CHIEF ENGINEER'S DEPARTMENT,
AREA BOARD HEADQUARTERS,
MANCHESTER, 8

APPLICANTS for post (*a*) should have had experience in the design and erection of M.V. and H.V. overhead lines up to and including 33 kV together with line calculations and field survey.

Experience in estimating for overhead and underground mains will be considered an advantage.

Commencing salary within range £649/£790 p.a. rising subsequently to £883 p.a. Class AX/EX, Grade 5, N.J.B. Conditions.

Applicants for post (*b*) should have had a good technical training and Drawing Office experience in the electrical design, layout and detailing of indoor and outdoor substations up to and including 33,000 V, together with the preparation of protection system schematic and wiring diagrams.

Preference given to applicants who hold the O.N.C. and/or H.N.C. in Electrical Engineering.

Salary within range £433/£567 p.a. according to qualifications and experience. Schedule "D" Grade 6. N.J.B. Conditions.

Applications to Establishment Officer, The North Western Electricity Board, Cheetwood Rd, Manchester, 8, by 30 Oct., 1954.

APPOINTMENT OF
SENIOR SALES REPRESENTATIVE,
NORTH DISTRICT, SALFORD

Duties include advising consumers (either at District Office or at the consumers' premises) on all matters normally concerned with sales development, i.e. tariff queries and apparatus sales for domestic and small commercial and industrial applications.

The successful applicant, if not already qualified, will be expected to undertake approved training courses.

Salary Scale: £485/£545 p.a., Grade 2, N.J.C. Conditions.

Applications to Sub-Area Secretary, No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493 by 30 Oct., 1954.

APPOINTMENT OF
1ST ASSISTANT DISTRICT COMMERCIAL ENGINEER,
BURY DISTRICT

Duties will include assisting the District Commercial Engineer as follows:

Organisation and control of all commercial staff and functions in the District, including the supply of information and advice to consumers on electricity utilisation, tariffs, terms, apparatus, routine testing and repair of domestic appliances, and all matters concerning electricity services.

Salary Scale: £791/£818 p.a. Grade F.5, N.J.B. Conditions.

Applications to the Sub-Area Manager, No. 2 Sub-Area, The North Western Electricity Board, National Bldgs, St. Mary's Parsonage, Manchester 3, by 30 Oct., 1954.

APPOINTMENT OF
DISTRICT ENGINEER,
STALYBRIDGE DISTRICT

Applicants should have had a sound training in Electrical Engineering together with considerable experience in the construction, operation and maintenance of substations and underground and overhead networks up to and including 33 kV. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £1,068/£1,215 p.a. Grade G.2, N.J.B. Conditions.

APPOINTMENT OF
SECOND ASSISTANT ENGINEER,
(PROTECTIVE GEAR TESTING),
SUB-AREA ENGINEER'S DEPARTMENT
STALYBRIDGE

Applicants should have had experience in the testing and maintenance of protective gear and in handling modifications to such equipment, commissioning tests on substations up to 33 kV including applied high voltage tests and maintenance of automatic tap changing equipment. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £869/£907 p.a. Grade K.7, N.J.B. Conditions.

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Applications for above posts to Sub-Area Manager, No. 3 Sub-Area, The North Western Electricity Board, Union St, Oldham, by 30 Oct., 1954.

APPOINTMENT OF
SECOND ASSISTANT DISTRICT ENGINEER,
BLACKBURN DISTRICT

Duties will include assistance in the operation, maintenance and construction of underground and overhead mains, substations and transformers. The successful candidate will be required to undertake standby duties.

Preference given to applicants who are Corporate or Graduate Members of the Institution of Electrical Engineers, or who possess the H.N.C. in Electrical Engineering.

Salary Scale: £729/£758 p.a. Grade G.7, N.J.B. Conditions.

Applications to Sub-Area Manager, No. 5 Sub-Area, The North Western Electricity Board, Jubilee Street, Blackburn, by 30 Oct., 1954. (N 456)

BRITISH ELECTRICITY AUTHORITY

South Wales Division

Vacancy No. 100/54

APPLICATIONS invited for superannuable N.J.B. appointment of SECOND ASSISTANT ENGINEER in the Generation (Operation) Department, Divisional Headquarters. Salary AX/CX.2—£834/£1,025 per annum.

Corporate Membership of the Institution of Electrical Engineers or equivalent qualifications desirable; duties will include System Operation Liaison between Division, Grid Area Control and Area Board, necessitating knowledge of interconnected power stations, operation and maintenance of power station plant.

Application forms obtainable from Secretary, South Wales Division, British Electricity Authority, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 5 Nov., 1954. (N 471)

ELECTRICITY AUTHORITY OF CYPRUS

ELECTRICAL ENGINEER

THE Electricity Authority of Cyprus require an Electrical Engineer for the two tours, each of 2 years, with prospect of permanency. Commencing salary in scale £1,200 rising to £1,500 a year according to qualifications and experience. Free furnished quarters and passages. Liberal leave on full salary. Candidates, between 28 and 40, must have had sound training in both electrical and mechanical engineering with experience in the practical and administrative operation of electricity supply undertakings. They should possess competent knowledge of the operation and maintenance of 33 kV or 66 kV systems and the erection and maintenance of high and low voltage overhead and underground A.C. transmission systems, networks and substation plant. Preference will be given to Corporate Members of the Institution of Electrical Engineers. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/40498/EE. (N 468)

BRITISH ELECTRICITY AUTHORITY

North Eastern Division

APPLICATIONS are invited for the position of SHIFT CHARGE ENGINEER at York Power Station.

Applicants should have had wide experience in the operation of generating plant and the possession of a Higher National Certificate or equivalent qualification would be an advantage.

The salary for this appointment (which is superannuable) will be in accordance with the National Joint Board Agreement, Schedule "A," Grade 7, Class E (£649/£681 per annum).

Forms of application may be obtained from Divisional Establishments Officer, British Electricity Authority, North Eastern Division, Carliol Hse, Newcastle-upon-Tyne 1, to whom they should be returned to arrive not later than 3 Nov., 1954. (N 474)

AMENDED ADVERTISEMENT

SOUTH EAST SCOTLAND ELECTRICITY BOARD

SECOND ASSISTANT ENGINEER (Commercial) Southern Sub-Area Headquarters. N.J.B. G.7 (£729/£758 p.a.). Candidates (preferably qualified to H.N.C. standard) should have sound experience of electrical contracting, including preparation of specifications and tenders, knowledge of I.E.E. and Factory Regulations, operation of an electrical appliance repair workshop and Service Centre administration.

Applications in response to the original advertisement will be considered unless applicants advise otherwise.

Applications stating age, qualifications and experience should reach the Board at High Street, Galashiels, within 14 days. (N 450)

SOUTH WALES ELECTRICITY BOARD

require ASSISTANT ENGINEER, District 105/6 (Carmarthen), Western Sub-Area.

Applicants should have sound experience of the layout and construction of mains and substations in mainly rural areas.

Salary—Class D, Grade 7 (£633/£638/£643) of N.J.B. Schedule.

Applications stating age, present position, salary, qualifications, experience, and three referees, to be addressed to the Secretary to arrive by 30 Oct., 1954.

D. G. DODDS,
Secretary.

St. Mellons,
Cardiff. (N 435)

SOUTH WESTERN ELECTRICITY BOARD

ENGINEERING DRAUGHTSMEN (TWO)—
CENTRAL CONSTRUCTION DEPARTMENT—
TAUNTON

SALARY N.J.B. Schedule "D," Grade 6, £433/£567 p.a.

Duties will include the preparation of engineering drawings, substation building site and layout plans, mains and statistical records.

Knowledge of overhead line design is essential and surveying experience and profiling will be an advantage.

Application forms obtainable from Assistant Secretary (Establishments), Electricity Hse, Bristol 1, should be returned by 3 Nov., 1954. (N 476)

A LEADING Cable Manufacturer wishes to appoint MANAGER to its branch in Birmingham. Applicants should have wide background in the cable industry and preferably be Corporate Members of the Institution of Electrical Engineers.—Box No. 3943, Electrical Times. (N 497)

A LEADING Cable Manufacturer wishes to appoint SALES ENGINEERS to its staff in London, capable of handling sale of paper and rubber cables both at home and overseas. Applicants should have wide background in the cable industry and preferably be Corporate Members of the Institution of Electrical Engineers.—Box No. 3945, Electrical Times. (N 498)

APPLICATIONS are invited for RADIO AND TELEVISION SALESMAN-MECHANIC. Applicants must be able to service and maintain all types of Radio and TV sets, and must possess qualifications of the recognised Trade bodies. No house available. Applications, in writing, stating age, experience, wages required (no overtime paid) with copies of recent testimonials to be sent to General Manager, Musselburgh and Fisherrow Co-operative Society Ltd., Musselburgh, not later than Monday, 25 Oct., 1954. (N 430)

ASSISTANT POWER PRODUCTION SUPERINTENDENT wanted for Canadian owned 75,000 kW public utility in Maracaibo, Venezuela. Age 30-40, preferably married. Previous experience turbines and oil-fired boilers essential. Permanent engagement, good salary, ample period and local leave. Applications with brief qualifications in writing only to Messrs Mackness and Shipley, Parliament Mansions, Abbey Orchard St, London, S.W.1, who will provide full particulars. (N 465)

THE BRITISH THOMSON-HOUSTON CO., LTD.

invites applications from men of initiative to join their sales organisation which is responsible for handling all B.T.H. electrical and mechanical plant, both heavy and light.

Openings exist in Rugby, London and the Provinces for men with ability seeking advancement: duties range from co-ordination of engineering and commercial handling of contracts at head office, to district representation.

Commercial experience is not essential but candidates should have received practical training in electrical engineering and possess a degree, Higher National Certificate or equivalent. Appointments include membership of pension scheme after qualifying period.

Applications, which will be treated as confidential, should be addressed to the British Thomson-Houston Co., Ltd., Sales Management, Rugby, and should include particulars of age etc., technical qualifications and previous experience. Interviews will be arranged locally where possible to suit selected candidates. (N 444p)

AN opportunity occurs in progressive manufacturing concern in London area for ENGINEER aged 25/35 with electrical or physicist degree, on development and research work on high frequency, telecommunication cable and associated testing equipment. Salary will be commensurate with qualifications and experience. Apply giving full particulars to—Box No. 3893, Electrical Times. (N 324)

ASSISTANT ELECTRICAL ENGINEERS wanted for Hydro-Electric Public Utility, Plateau, Nigeria. Age 25-35, single men preferred but married men considered. H.N.C. standard or equivalent, good salary and leave conditions. Pension scheme. Written applications only with brief particulars to Messrs Mackness and Shipley, Parliament Mansions, Abbey Orchard St, London, S.W.1, who will provide full particulars. (N 464)

BRITISH ELECTRICITY AUTHORITY, Transmission Design Branch, Headquarters, London, require POWER CIRCUIT ENGINEER to co-ordinate the work of two small groups of Engineers responsible for the Design, Specification and Testing of Overhead Lines and Cables. Candidates should have special experience with one of these types of equipment and some knowledge of the practice and principles associated with the other. Good personality and initiative to keep abreast of modern developments is of first importance.

Salary N.J.M. Scale 4, £1,650 by £50 to £1,800 inclusive of London Allowance. Candidates should preferably be Corporate Members of the I.E.E. Forms from D. Moffat, Director of Establishments, British Electricity Authority, Winsley St, London, W.1, to be returned by 6 Nov., 1954. Quote Ref.: ET/532. (N 438)

BRITISH ELECTRICITY AUTHORITY Research Laboratories, Leatherhead, require JUNIOR ENGINEER. Candidates should have H.N.C. in Mechanical Engineering or equivalent qualification. Duties include testing of fly ash concrete and other materials. Salary N.J.B. Grade 6, £390/£606 p.a. Applications to D. Moffat, Director of Establishments, Winsley St, London, W.1, by 6 Nov., 1954. Quote Ref. 535. (N 484)

Electrical Research Assistant

A large organisation in the North-West wishes to appoint a young man to evaluate the electrical properties of new insulation products. Possession of Higher National Certificate in Electrical Engineering is desirable. Apply to—Box No. 3937, Electrical Times. (N 490p)

BRITISH ELECTRICITY AUTHORITY Production Inspection and Test Sub-Branch require THIRD ASSISTANT ENGINEER (MECHANICAL) in the Manchester Regional Office. Candidates should possess educational and engineering qualifications up to the standard required for Graduate Membership of the I.Mech.E. Duties are associated with production, inspection and testing of power station plant and equipment in Manufacturers' Works. Recent experience of such work and actual construction and plant erection at power stations would be considered an advantage.

Salary N.J.B. Grade 4, £717/£934. Applications stating age, qualifications, experience, present position and salary to D. Moffat, Director of Establishments, Winsley St, London, W.1, by 6 Nov., 1954. Quote Ref. ET/534. (N 467)

BRITISH ELECTRICITY AUTHORITY, Generation Station Construction, Civil Engineering Branch, Headquarters, London, requires SENIOR ASSISTANT ENGINEER. Duties include critical examination and reporting on the development of Projects, procedure leading to letting of contracts, and consideration of prices and claims in respect of Power Station Construction. Candidates should preferably be Corporate Members of the Inst.C.E. and have field experience on major civil engineering works with Consulting Engineers or Contractors in Gt. Britain, preferably including work on power station construction. Knowledge is essential of methods of construction, administration of works contract practice and procedure, costing and pricing of work and adjustment of claims. Salary N.J.B. Grade 1, £1,002 to £1,378 inclusive. Applications stating age, qualifications, experience, present position and salary to D. Moffat, Director of Establishments, Winsley St, London, W.1, by 6 Nov., 1954. Quote Ref.: ET/533. (N 451)

BRUSH ELECTRICAL ENGINEERING CO., LTD., Loughborough, Leics, has a vacancy for a RESEARCH ENGINEER to assist with projects connected with high voltage technology and the development of power transformers. A good Degree in Electrical Engineering or Physics is necessary with experience of transformer design, manufacture, or associated techniques. Consideration will be given to candidates with suitable educational qualifications and experience of research in kindred fields who wish to develop further knowledge and experience in this important work. Existing facilities provide opportunities for original research. Please write with full details to the Chief Personnel Officer. (N 440)

CEYLON European controlled Company seeks ELECTRICAL ENGINEER with minimum qualifications National Higher Certificate, preferably unmarried, sound practical knowledge of A.C. and D.C. distribution, alternator and generator installation and maintenance. Estimating and sales experience an advantage. Salary approximately £90 per month, provident fund, medical and other benefits. Write Box ZS.491, Deacon's Advertising, 36 Leadenhall St, London, E.C.3. (N 486)

DRAUGHTSMAN-DESIGNER

for "Ellison" Electric Switchgear of up to 11 kV. Opportunity for man with the right qualifications seeking advancement. Five-day week, bonus, non-contributory pension scheme, excellent working conditions, canteen and welfare facilities, are some of the advantages offered to employees in this privately owned organisation. Temporary living accommodation can be arranged. Send full particulars and salary requirements to The Personnel Manager, George Ellison Limited, Perry Bar, Birmingham 22B. (N 491p)

ELECTRICAL ENGINEER

required (aged 30-40, preferably Chartered), to assume leading position—commanding equivalent £1,000 p.a. to start—in Design Office of London Company. Applicants must be fully conversant with low and medium voltage automatic contactor gear, motors, relay systems, and methods of temperature control. Previous D.O. experience and a thorough knowledge of wiring systems applied to precision machinery is essential. Write in first instance: Personnel Manager, Molins Machine Co., Ltd., Evelyn St, London, S.E.8. (N 442p)

CONSULTING Engineers require a JUNIOR ASSISTANT ENGINEER. Applicants should have had some experience of the preparation of drawings and specifications for the electrical installations in hospitals, schools, commercial premises, etc. Applications should be submitted in writing to Barlow, Leslie and Partners, 5 Catherine Place, S.W.1, not later than 5 Nov., and should state age, experience and salary required. (N 452)

DESIGN DRAUGHTSMAN. An excellent opportunity occurs with housing assistance available for a first class Designer Draughtsman with experience of Light/Medium Electro-Mechanical equipment for development work on battery electric trucks of advanced design. A substantial salary is offered to a man of proved ability. Applicants should be of H.N.C. standard, must have an original outlook and be capable of taking charge of a job from its conception to the production stage. Modern factory in country district, 1 hour London. Reply in confidence giving all details to—Box No. 3947, Electrical Times. (N 499)

DESIGN ENGINEER for power rectifiers is required by a large manufacturing organisation in the Midlands, for work of exceptional technical interest with good prospects. No previous rectifier experience is necessary, but candidates should have degree and some practical training. Excellent residential and educational district. Please write with full details to Box No. 1364, T. and G., 167 High Holborn, London, W.C.1. (N 329)

DRAUGHTSMEN with sound experience in the design of High Voltage Isolating Switches and Fuses 11,000 V and above. Very good prospects for fully-trained draughtsmen. Write giving particulars of experience, age and salary required to—Box No. 3915, Electrical Times. (N 393)

DRAUGHTSMAN required for Electric Elements and Thermal Devices Manufacturers. Knowledge of presswork and press tool design an advantage. A distinct opportunity. House available if required. Five-day week. Pension Scheme, Canteen, etc. State briefly age, experience, technical training, salary, whether married with family, to Best Products Ltd., Felix Rd, Felixstowe, Suffolk. (N 437)

THE GENERAL ELECTRIC COMPANY LIMITED

have a number of vacancies at their Fraser and Chalmers Works for both

ELECTRICAL AND MECHANICAL ENGINEERS

aged 28 to 40, preferably with an Engineering degree or its equivalent for development work in connection with Nuclear Power Stations.

Apply giving particulars of training and experience to

Personnel Manager, Fraser and Chalmers Engineering Works, Erith, Kent (N 296p)

DRAUGHTSMEN. Senior Development Draughtsmen required with previous experience of E.H.T. and L.T. Switchgear or Motor Control Gear. Pension scheme in operation. Excellent conditions. Apply by letter, giving particulars previous experience, age and salary required to Erskine, Heap and Co., Ltd., Lancashire Switchgear Works, Manchester 7. (N 443)

DRAUGHTSMAN required with experience of metalclad medium voltage switchgear. Unfurnished house available. A.E.S.D. rate minimum. Reply stating age and experience to Ottermill Switchgear Ltd., Ottery St. Mary, Devon. (N 351)

DRAUGHTSMAN required (Victoria Area) for Manufacture of L.T. Switchgear and General engineering. Prospects for man with initiative. Write age, experience and salary required.—Box No. 3921, Electrical Times. (N 417)

ELECTRICAL DRAUGHTSMEN required for the Rugby drawing offices of the BTH Co., Ltd., accustomed to making schematic diagrams of electrical control schemes from engineers' drafts and preparing complete wiring diagrams.

Apply in writing, giving details of age, experience, etc., to Manager, Drawing Offices, British Thomson-Houston Co., Ltd., Rugby. (N 470)

ELECTRICAL ENGINEER required by Large Industrial Undertaking for one of its enterprises in British West Africa. Applicants should be between the age of 33 and 38, and should have experience in the operation of medium capacity a.c. generating plants, M. and H.T. transmission and M.T. distribution systems, and the electrical maintenance of industrial type motors and switchgear. Corporate membership of the Institution of Electrical Engineers or equivalent technical qualification is desirable but not essential.

Commencing salary will be dependent on qualifications, experience and age, but for a qualified engineer it will not be less than £1,400 per annum. Terms of service include family allowances, retirement benefits, free passages to and from Africa, and free medical attention and furnished quarters in West Africa. Tours of 21 months each followed by leave on full pay.

Write giving full particulars of experience to—Box No. 8061, c/o Charles Barker and Sons Ltd., 31 Budge Row, London, E.C.4. (N 441)

ELECTRICAL ENGINEER SURVEYOR required for relief work. Must be prepared to travel anywhere in U.K. Permanent area may be available later on. Higher National Certificate essential with practical experience on maintenance. Salary £540, rising by annual increments to £875. Pension non-contributory. Age not over 32. Apply in writing, Manager, Engineering Department, General Accident Assurance Corporation, 99 Aldwych, W.C.2. (N 448)

SIMPLEX ELECTRIC CO., LTD.
Development Department
APPOINTMENT OF
DEVELOPMENT ENGINEER

Applications are invited for the position of senior engineer in the Development Department at Creda Works, Blythe Bridge, near Stoke-on-Trent, for work on Creda cookers and associated products. This is a position of considerable responsibility and carries an appropriate salary.

Applications in writing giving full details of qualifications and experience should be addressed to The Secretary, Simplex Electric Co., Ltd., Oldbury, Birmingham. (N 366 p)

ELECTRICAL ENGINEER required to take charge of Electrical Section of Drawing Office in London Contracting Firm. Applicants should hold qualifications at least up to H.N.C. standard. Write stating age, experience, qualifications and salary required to—Box No. 3941, Electrical Times. (N 496)

ELECTRICAL ENGINEER, fully qualified, with extensive experience in the installation of electrical equipment, transformers, switchgear and cables up to 11 kV pressure for heavy industrial equipment preferably as associated with Iron and Steelworks plant, required by Consulting Engineers for 4 year contract on major extensions to iron and steel plant in West Bengal, India. Reply to—Box No. 3911, Electrical Times. (N 386)

ELECTRICAL FITTERS are required by the British Electricity Authority at their Nottingham Transmission Section. The nature of the work involved includes the overhaul of 132,000 V Transformers and switchgear at Transforming Stations within the Nottingham Section. Previous experience of H.V. apparatus would be an advantage. Rate of pay 45d. per hour, 44-hour week. Terms and conditions of service in accordance with N.J.I.C. Agreement. Applications in writing to Divisional Establishments Officer, British Electricity Authority, P.O. Box 25, Barker Gate, Nottingham. Please quote Vacancy No. 160/54/ET. (N 483)

ELECTRO MECHANICAL DRAUGHTSMEN, Senior and Junior, required for the British Thomson-Houston Co.'s Electronics Drawing Offices at Rugby and Leicester.

Apply in writing, giving details of age, experience, etc., to Manager, Drawing Offices, British Thomson-Houston Co., Ltd., Rugby. (N 469)

ENFIELD CABLES LTD. urgently require OVERHEAD LINESMEN used to work on 33 kV lines, for a contract at Peterborough. Write giving full details to the Contracts Dept., Lockfield Ave, Brimsdown, Middlesex. (N 457)

JOINTERS and ELECTRICIANS and MATES required London Power Station Contract including Saturday and Sunday working. (WAT 5891.) (N 487)

JUNIOR DESIGNERS required to deal with small transformers, power, audio, pulse, etc. Specialised training will be given to engineers with suitable basic training and experience. Applications to Technical Director, Gresham Transformers Ltd., Twickenham Rd, Hanworth, Middx. (N 275)

JUNIOR LIGHTING ENGINEER to assist in preparation of designs for modern interior installations. Commencing salary up to £450 p.a. according to experience. Write giving full details to—Box No. 3931, Electrical Times. (N 454)

LABORATORY ENGINEER, H.N.C. or equivalent. Experienced Magnetic Amplifiers and control circuits. Housing and Pension Scheme available. Apply Personnel Manager, Electro Methods Ltd., Caxton Way, Stevenage, Herts. (N 391)

LARGE European controlled company in Ceylon require ASSISTANT ELECTRICAL ENGINEER, age 20/30 years, preferably unmarried, sound knowledge of A.C. and D.C. distribution and work covered by general electrical contractors. Attractive terms to right man. Write Box ZT.492, Deacon's Advertising, 36 Leadenhall St, London, E.C.3. (N 485)

MANAGER for Electrical Wholesaler, London. Previous experience of the trade and in the control of staff essential. Salary £1,000. Pension scheme. Permanent position and excellent prospects for efficient man.—Box No. 3925, Electrical Times. (N 445)

Draughtsmen
required for Automatic Electric Control Gear; 5-day week; excellent working conditions; Canteen facilities; convenient transport; Incentive Bonus; Superannuation Scheme; salary according to qualifications, ability and experience. Apply Asst. Sec.: Watford Electric and Mfg. Co., Ltd., Watford, Herts. (N 385p)

MECHANICAL DRAUGHTSMAN wanted for factory in West Midlands. Permanent and pensionable post, attractive working conditions. Starting salary up to £700 according to age and qualifications. Experience of design of malleable castings an advantage. Apply, giving particulars of age, qualifications and experience, to—Box No. 3929, Electrical Times. (N 453)

REPRESENTATIVE Lancashire / Yorkshire, required by leading firm producing Appliance Switches and motor Control Gear. Excellent opening for man with good connections amongst manufacturers. Will be required to join staff and should possess car. Write, giving full particulars and remuneration expected, to—Box No. 3933, Electrical Times. (N 459)

REPRESENTATIVES with established connections amongst Electrical Retailers required. Commission basis.—Box No. 3899, Electrical Times. (N 362)

SENIOR TRANSFORMER DESIGNER required with experience of all types of transformers up to 3,000 kVA. Excellent prospects for an energetic man capable of supervising junior engineers. Excellent working conditions, Pension Scheme, Canteen, etc. West London area. Applications to—Box No. 3877, Electrical Times. (N 277)

STEAM PLANT SUPERINTENDENT wanted for Canadian owned 12,500 kW public utility in Georgetown, British Guiana. Age 30-40, preferably married. Good experience with oil-fired boilers and steam turbines essential. Good salary. First class passages; three months' leave at end of three year period, and interim local leave; house with electric cooker and refrigerator provided at nominal rental; present Superintendent being transferred to larger property. Applications with brief qualifications in writing only to Messrs Mackness and Shipley, Parliament Mansions, Abbey Orchard St, London, S.W.1, who will provide full particulars. (N 466)

TECHNICIAN required by The General Electric Co., Ltd., for installation and maintenance of H.F. equipment at their Wembley Works. Applicants should have had previous experience in this type of work and be prepared to travel in this country. Preference will be given to those who have obtained their O.N.C. in electrical engineering or the equivalent and are not over 26 years of age. Apply in writing quoting reference P.H. to the Staff Manager, Magnet House, Kingsway, W.C.2. (N 488)

TOOLMAKER, practical and versatile, for newly-equipped toolroom. Experienced in presswork up to 200 tons, including deep drawing essential. Must be capable of working on own initiative. Good prospects. Best Products Ltd., Felix Rd, Felixstowe, Suffolk. (N 436)

TRANSFORMER DRAUGHTSMEN required, fully experienced up to 2,000 kVA 66 kV, 5-day week, pension scheme. Apply to: Chief Mechanical Engineer, Hackbridge and Hewittic Electric Co., Ltd., Walton-on-Thames, Surrey, giving details of experience and salary required. (N 320)

Required
ELECTRICAL AND RADIO DRAUGHTSMEN
Apply to
Employment Manager,
Vickers-Armstrongs Limited
(Aircraft Division)
Hurn Airport Nr. Christchurch, Hants.

TECHNICAL SERVICE ENGINEER required by leading electric cooker manufacturer for an area approximating to the South Wales and South Western Electricity Boards. Residence in the Bristol area will, therefore, be necessary. The successful applicant should have a thorough knowledge of electric cookers, and whilst the position will entail some manual work, in general it will involve calling at repair depots with information and guidance. The position might offer to a suitable person, the possibility of promotion to Technical Representative, at a later date. State present salary, and give full details to Box No. 3041, c/o 117 Piccadilly, London, W.1. (N 495)

TRANSFORMER DRAUGHTSMAN, experienced up to 10 MVA, 33 kV, progressive appointment, pension scheme. Write, stating age, salary and experience, to Yorkshire Electric Transformer Co., Ltd., Dewsbury. (N 439)

WELL-KNOWN electrical manufacturing Company has a vacancy for a SALES ENGINEER for electrical rotating machinery in Sheffield. Successful applicant must be a trained Electrical Engineer with O.N.C. as a minimum qualification and with previous sales experience in the area covered. He will work from the Company's existing Branch Office. Remuneration by salary and expenses. Non-contributory pension scheme. Apply Box No. 3949, Electrical Times (N 500)

APPOINTMENTS WANTED

NAVAL ELECTRICAL OFFICER, 29 years of age, married, and available shortly, seeks progressive position in any part of the world, preferably Far East. Experience of A.C. and D.C. motors and control schemes from F.H.P. to 200 h.p. also propulsion equipment of 6,000 n.h.p. and auxiliaries.—Box No. 3883, Electrical Times. (N 280)

REPRESENTATIVE, 27, exp. domestic, industrial and marine electrical equipment, seeks position with firm supplying S.W. or Devon and Cornwall.—Box No. 3939, Electrical Times. (N 493)

WANTED

WANTED, D.C. and A.C. ball-bearing MOTORS, motor generator sets, dynamos and alternators.—Full details to Britannia Manufacturing Co., Ltd., 22-26 Britannia Walk, London, N.1. (N 10)

WANTED, for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of secondhand machinery and plant for re-use.—W. and H. Cooper Ltd. 176 Brady St, Bethnal Green, E.1. (N 9)

WANTED. ROTARY CONVERTERS, any size.—Universal, 221 City Rd, London, E.C.1. (N 11)

WORK WANTED

ARMATURE REWINDING service to the trade. Vacuums, Drills, Grinders, Hood Dryers, Dental Motors. Vacuum cleaner and drill armatures replaced from stock 24-hour service. Every job guaranteed. All vacuum cleaner parts, hoses, etc., in stock for any make. Apex washer agitator shafts stocked.—Regam Electric Cleaner Service 95 Park Lane, Leeds 1. (N 13)

A.C. and D.C. MOTOR REWINDS and REPAIRS. Prompt service fully guaranteed. Edgware 5566 (4 lines).—Service Electric Co., Ltd., Stanmore, Middx. (N 12)

FISHER FOUNDRIES LTD., Greet, Birmingham 11, for Machine Moulded Precision Castings in gun metal and soft grey iron. Tel.: Victoria 0197. (N 14)

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INDEX TO ADVERTISERS

Alton Battery Co. Ltd. 48
Aluminium Wire & Cable Co. Ltd. ... 1
Arrow Electric Switches Ltd. 3
Asea Electric Ltd. 15
Association of Steel Conduit Manufacturers 16
Astor Boisselier & Lawrence Ltd. ... 34
Attwater & Sons Ltd. 66

Backer Electric Co. Ltd. 28
Belling & Co. Ltd. 6
B. B. Chemical Co. Ltd. 68
British Electric Resistance Co. Ltd. ... 24
British Electrical Repairs Ltd. 5
British Insulated Callender's Cables Ltd. 41
British Thomson-Houston Co. Ltd. *Cover* (iv)
Browning's Electric Co. Ltd. 18
Brush Electrical Engineering Co. Ltd. 72
Burgess Products Co. Ltd. 17
Butcher, J. H., & Co., Ltd. 68

Cable Makers Association 73
Castell Locks Ltd. (*Industrial Maintenance*, 44)
Castle Engineering Co. (Nottingham) Ltd. 66
Clyde Blowers Ltd. 64
Connollys (Blackley) Ltd. 11
Cox Walkers Ltd. 72
Cressall Manufacturing Co. Ltd. ... 71
Crompton Parkinson Ltd. 27

Dimplex Ltd. 9
Dubilier Condenser Co. (1925) Ltd. ... 7

East London Mica Works 74
Edge, Arthur, & Co. Ltd. 68
Edison Swan Electric Co. Ltd. 4
Ekco-Ensign Electric Ltd. 19
Electric Construction Co. Ltd. ... *Cover* (ii)
Electrical Times Ltd. 63
E.M.S. Electrical Products Ltd. 14
Engel & Gibbs Ltd. 33
Engineering & Lighting Equipment Co. Ltd. 45
English Electric Co. Ltd. ... 49, 67

Falk, Stadelmann & Co. Ltd. 47
Ferranti Ltd. 23
Fischer Bearings Co. Ltd. 53
Foster Transformers Ltd. 80

General Electric Co. Ltd. ... 35, 52, 69
Gent & Co. Ltd. 44
Gillott Electro Appliances Ltd. 2
Grelco Ltd. 78
Griffiths, Gilbart, Lloyd & Co. Ltd. ... 14

Hackbridge Cable Co. Ltd. 70
Heatrae Ltd. 77
Henley's, W. T., Telegraph Works Co. Ltd. 55
Heyes & Co. Ltd. 28
Higgs Motors Ltd. 10
Hotpoint Electric Appliance Co. Ltd. 22

Igranic Electric Co. Ltd. 43
Industrial and Commercial Finance Corporation Ltd. 29
Insuloid Manufacturing Co. Ltd. ... 79

Johnson & Phillips Ltd. 42

King, Geo. W., Ltd. (*Industrial Maintenance*, 40)

Lister, R. A., & Co. Ltd.... 36
Locker's (Metal Perforators) Ltd. ... 20

Martindale Electric Co. Ltd. 76
Mek-Elek Engineering Ltd. (*Industrial Maintenance*, 44)
Metropolitan-Vickers Electrical Co. Ltd. 40
Midland Electric Manufacturing Co. Ltd. *Cover* (i)
Midland Packing Co. Ltd. 2
Midland Silicones Ltd. 13
Morley's Electrical Services Ltd. ... 76

Nalder Bros. & Thompson Ltd. ... 8
New Switchgear Construction Co. Ltd. 74

Parker Foundry Co. (1929) Ltd. ... 12
Parmiter Hope & Sugden Ltd. ... *Cover* (iii)
Partridge Jones & John Paton Ltd. ... 79
Partridge Wilson & Co. Ltd. 51
Passburg-Block-Haas G.m.b.H. 36
Phillips Electrical Ltd. 56
Premier Electric Heaters Ltd. 65

Radiovisor Parent Ltd. 34
Rawlplug Co. Ltd. (*Industrial Maintenance*, 44)
Resistances Ltd. 36
Reyrolle, A., & Co. Ltd. 38
Rowlands Electrical Accessories Ltd. ... 75

Saxonia Electrical Wire Co. Ltd. ... 76
Shell-Mex & B.P. Ltd. 39
Siemens Bros. & Co. Ltd. 32
Simmonds & Stokes (Niphan) Ltd. ... 2
Smith, Frederick, & Co. 37
Smith, W. H., & Son 78
Standard Telephones & Cables Ltd. ... 50
Sturdy Electric Co. Ltd. 24
Sunvic Controls Ltd. 54

Thorpe, F. W., Ltd. 70
T.M.C.-Harwell (Sales) Ltd. 26

Universal Boilers & Engineering Co. Ltd. 21

V.G. Porcelain Co. Ltd. 24
Vulcanised Fibre Ltd. 25

Wandleside Cable Works Ltd. (*Industrial Maintenance*, 40)
Washers Ltd. 76
Westinghouse Brake & Signal Co. Ltd. 31
Wootton & Co. Ltd. 20

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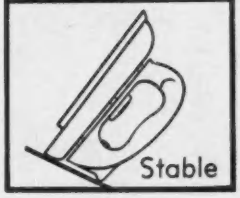

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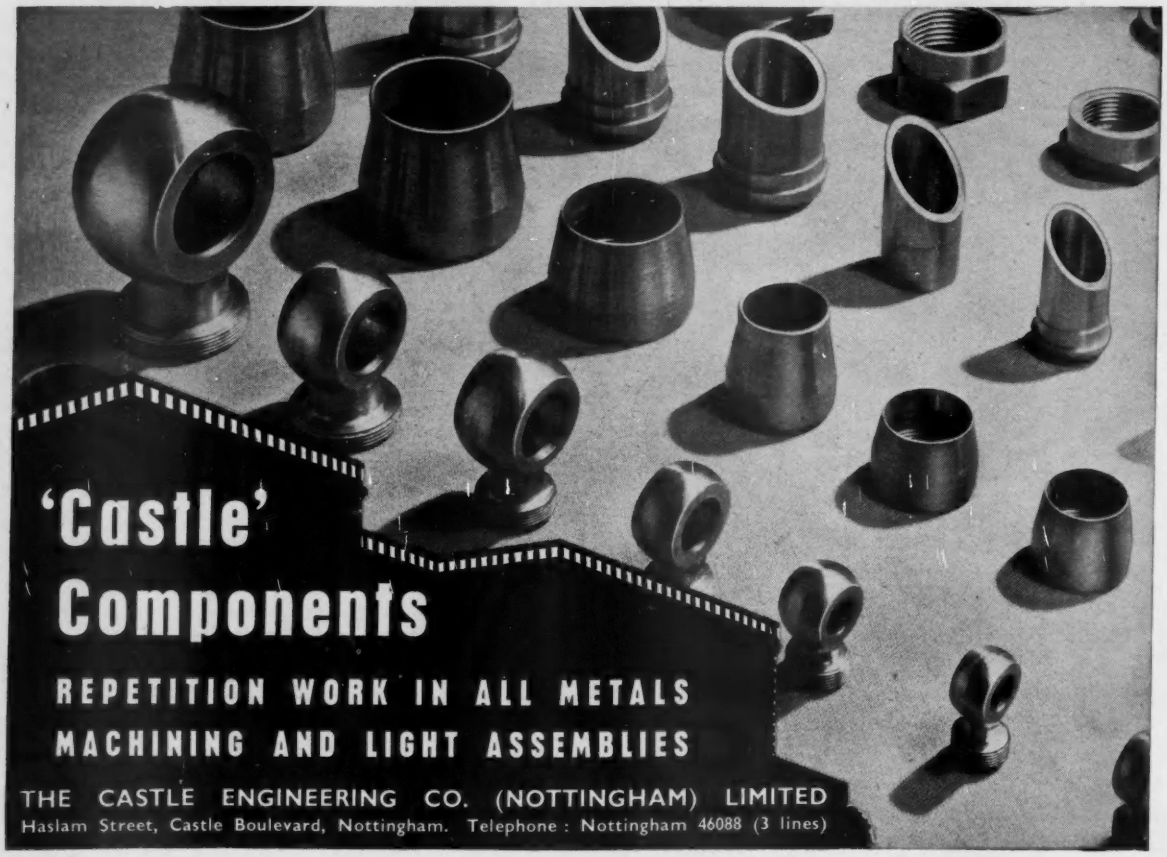
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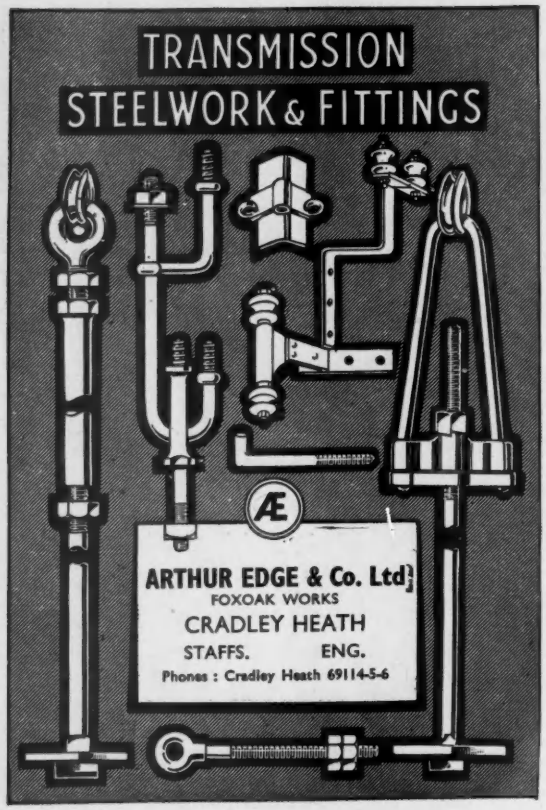

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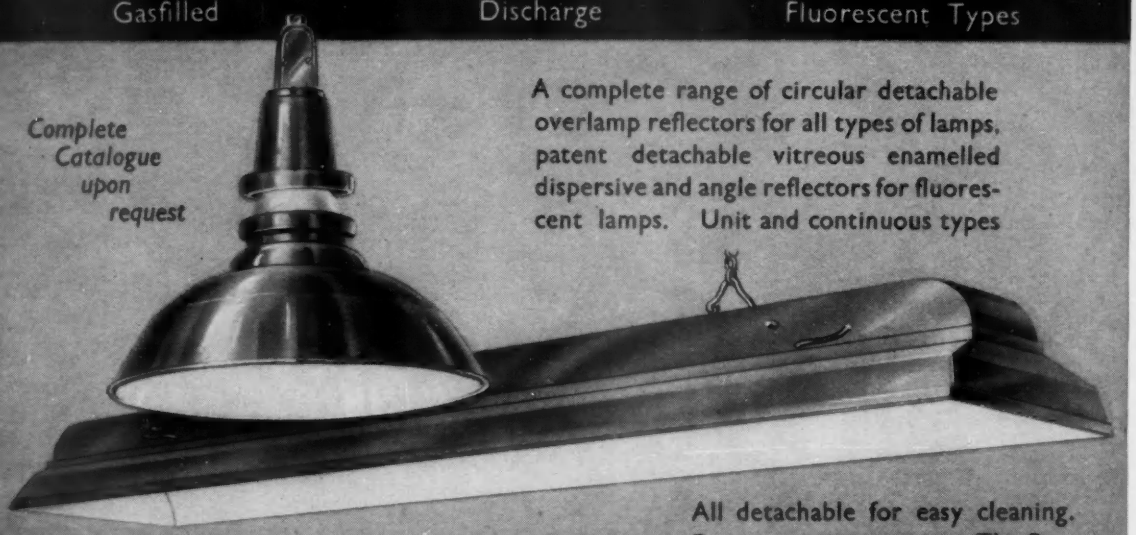

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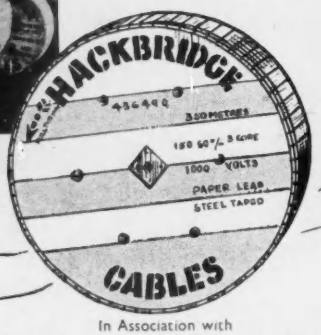

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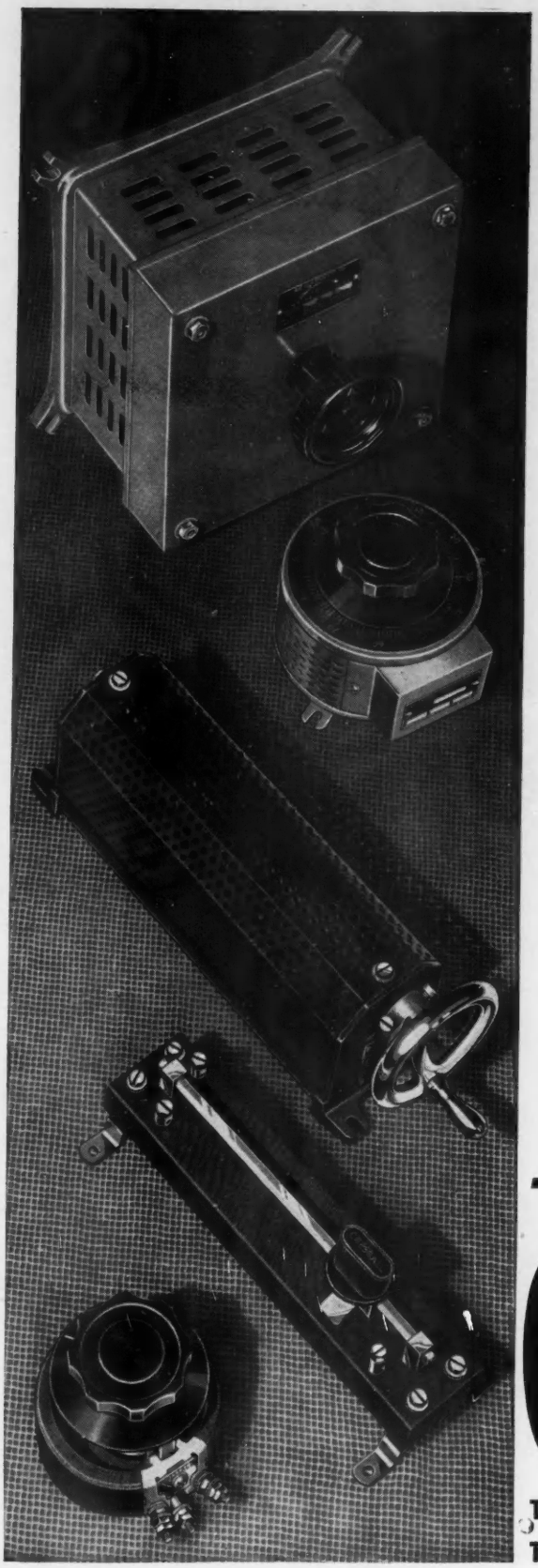

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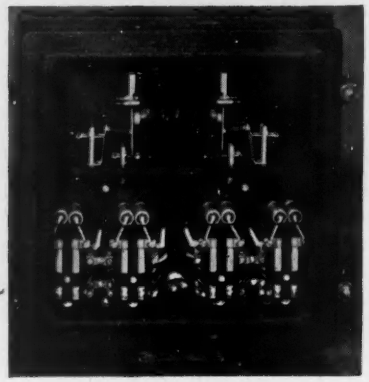

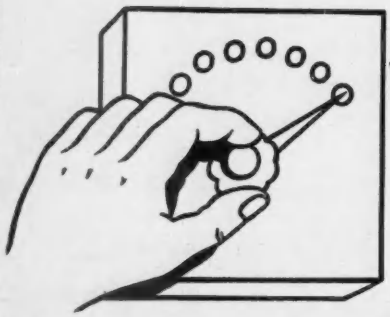

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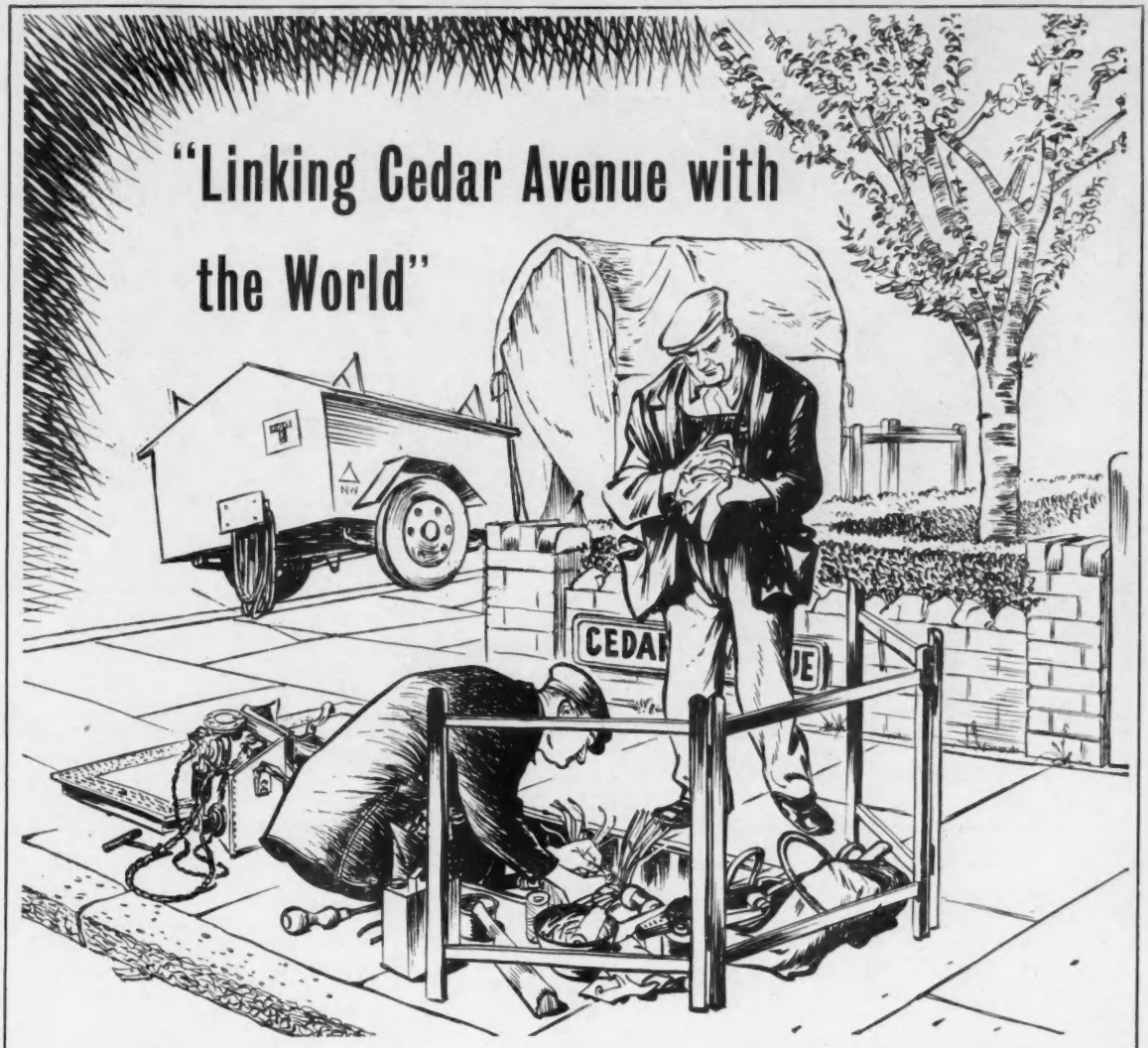

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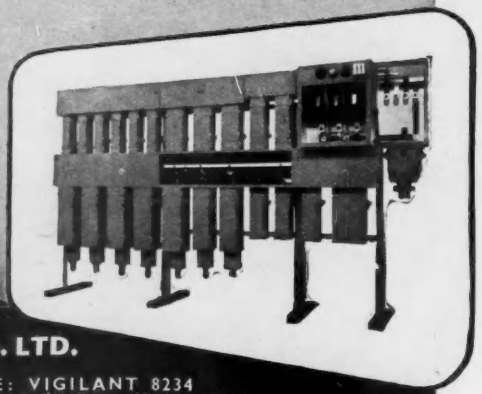

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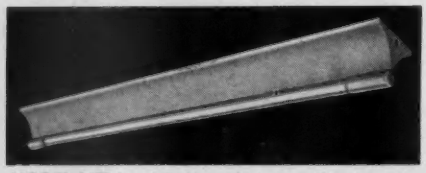

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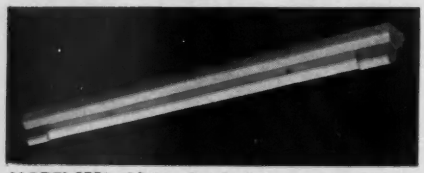

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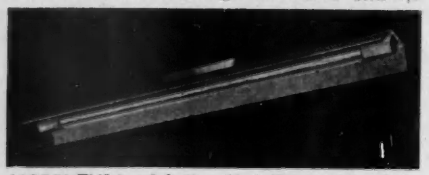

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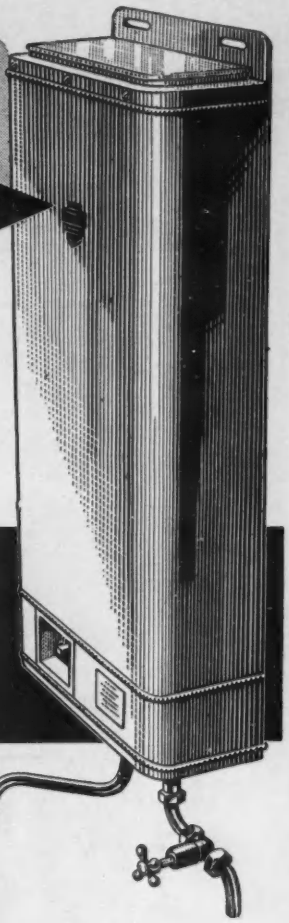

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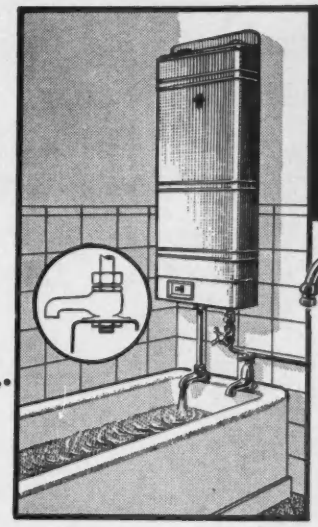

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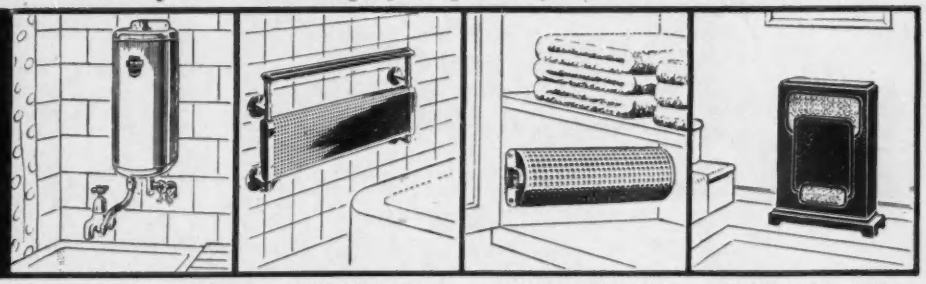

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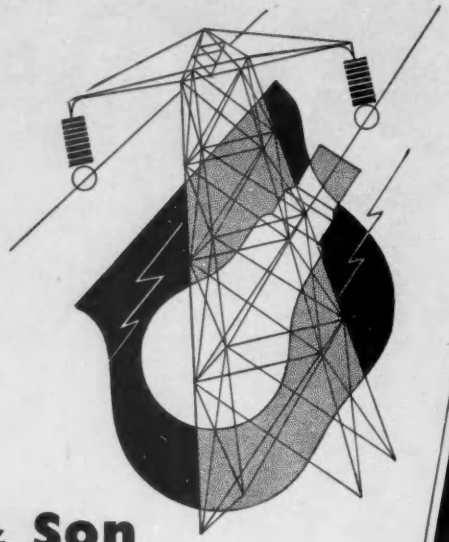

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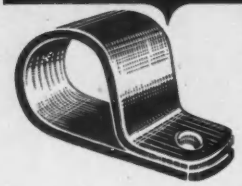

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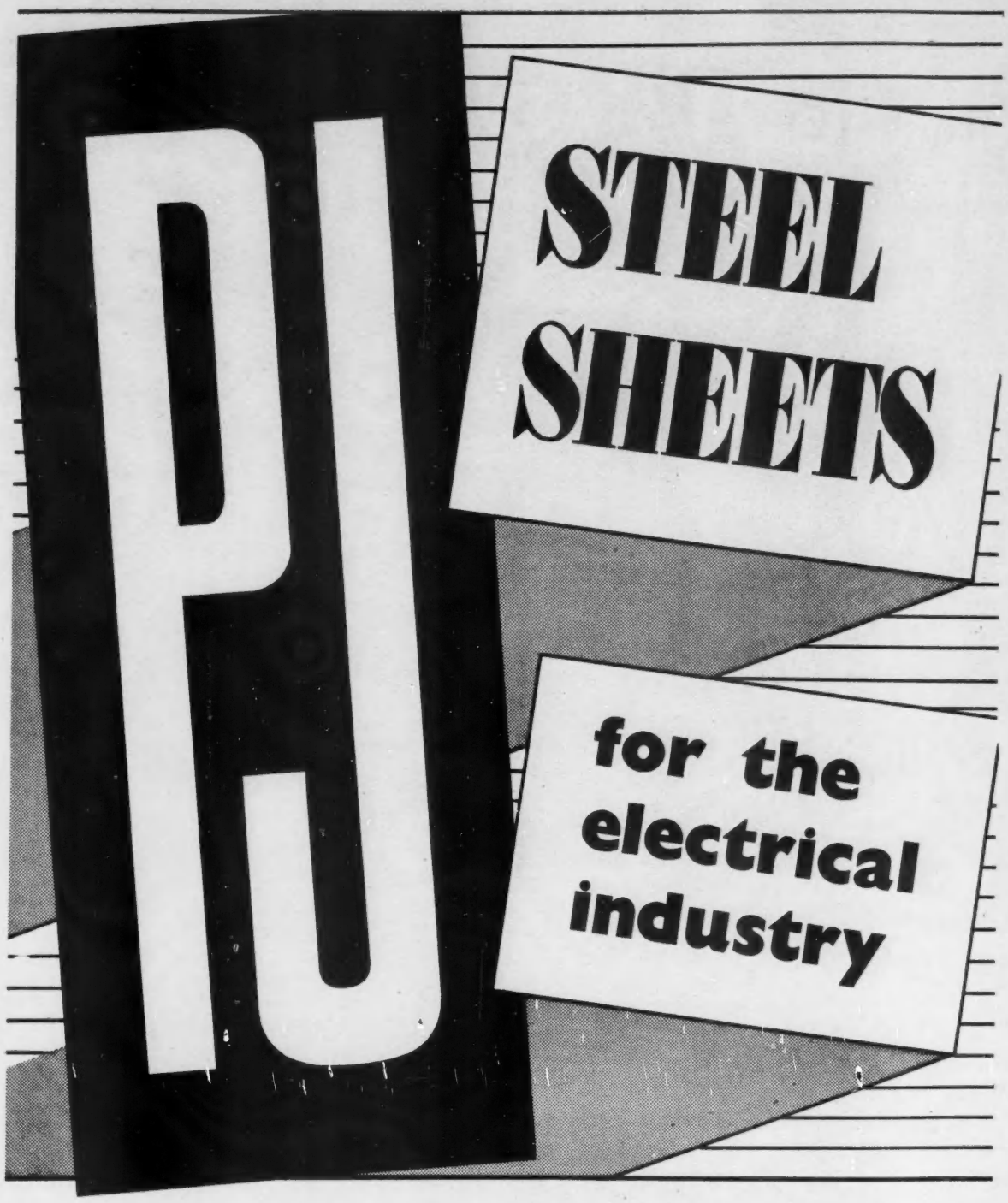

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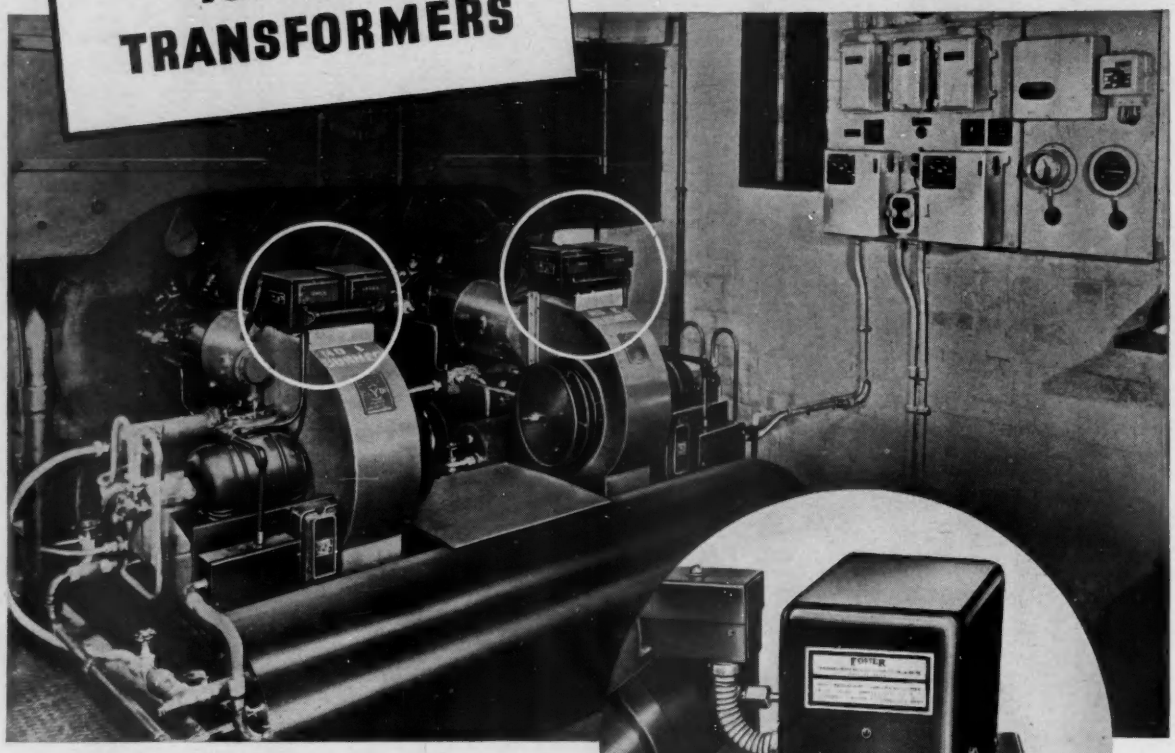

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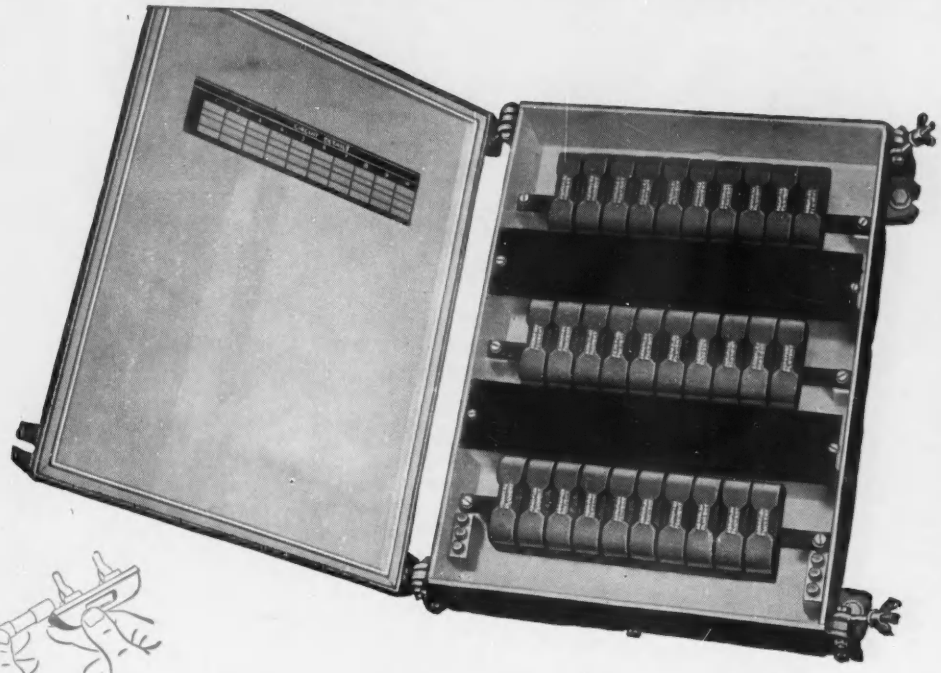

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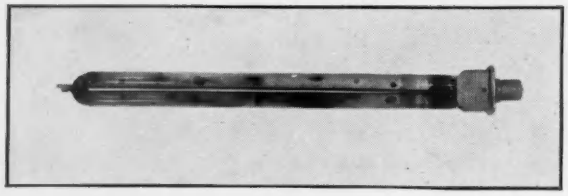

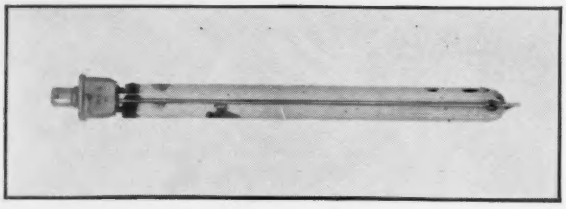

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